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Institution Meeting in Birmingham

FOR the first time the venue of this year's Annual Meeting of the Institution of Gas Engineers—the 84th—was the City of Birmingham; and the attendance (to be precise, 1,225) was fitting tribute to the President, Mr. G. C. Pearson. A torrid atmosphere dismayed nobody. Birmingham was being what it is—all-embracing through so many years of contact with visitors not merely from the Metropolis, but from Overseas. In the Town Hall, the meeting place throughout, the organ recital by Dr. G. D. Cunningham gave pleasant prelude to the proceedings. Following the final diapason, the Lord Mayor (Alderman A. F. Bradbeer) extended the City's welcome to everybody, hoping that the meeting as a whole would be the best that the Institution had known, even if the members and friends attending might feel tired and possibly exhausted at the conclusion of a packed programme.

And this brought Mr. Pearson face to face with the microphone and with his first duty at the meeting—a pleasant one, to welcome delegates from abroad, whose names were announced by the Secretary, Dr. W. T. K. Braunholtz. We record them here:

Belgian Association of Gas Engineers, M. R. H. Touwaide (Secretary); Czechoslovakian Gas Association, Dr. F. Perna (Brno); Danish Gas Association, Mr. A. Rasmussen (Svenborg); Gaz de France, M. B. de Comminges (Paris) and Professor Gustave Ribaud (Paris); Netherlands Gas Association, Mr. C. L. Philips (Nijmegen, President); Norwegian Gas-Works' Association, Mr. J. C. Irminger (Bergen); Swiss Gas and Water Association, Dr. Hs. Deringer (Winterthur, President). Col. H. Zollikofer (Zurich, Secretary, and also General Secretary of the International Gas Union). And the Secretary mentioned two overseas members of the Institution:—Mr. H. D. Greenwood (Control Commission for Germany) and Mr. T. Spikins (Shanghai).

G. C. Pearson, O.B.E., M.Inst.C.E., Institution President

Annual Report and Comments

Following the moving of the adoption of the 84th annual report of the Council by the President, and the accounts for the year 1946, Mr. F. C. Briggs ascended the platform. The platform, by the way, was draped beautifully by hydrangeas, but was, from the reporters' point of view somewhat awkward. In fact, the reporter had no view and no point except that of pen or pencil. Mr. Briggs had a determined point of view, adequately relayed by the "mike." We record his message:

"Through well over three-quarters of a century members of this Institution have been giving mutual assistance towards one goal, the more efficient use of the country's natural fuel resources. The Institution has pursued the true path of steady, sound, and progressive policy, as befits a body of engineers. When needs have arisen branching away from purely technical considerations, it has become the parent of new organizations to deal with them adequately.

"To-day, the Institution faces a revolutionary change which may well be the most important in its history. The Industry is threatened with a complete change of ownership, organization, and management, with the ultimate predominant power in the hands of a Minister politically appointed and subject to political pressure. Very few of us would be found to agree with the wisdom of such a radical change, particularly at the present time. We may consider that the nature of the actual ownership does not matter 'two hoots,'

Birmingham Town Hall—Venue of the Meeting

but the control is quite able to produce many 'cusses.' There must inevitably result some dislocation, much slowing up of endeavour and initiative, and often the frustration that results from those who advise and carry executive responsibility failing to meet those who decide policy. What an experience we already have of that!

"In the changes to be imposed upon us, it is vital that the Institution as a body, and its members as individuals, should spare no efforts to mitigate the evils which may so easily beset us, to the detriment of the service we strive to give.

"This Institution will remain alone of the national organizations, the only free and independent platform, the only channel of unfettered and constructive criticism. It may well be that the scope of its discussions may, in the future as in the past, have to be widened. Be that as it may, those who guide the destinies of the Institution will need, and can be assured of, the loyalty and support of us all.

"There is one specific point in the report to which I feel constrained to call special attention. In connexion with the Gas Engineers' Guild, the Report states 'the Council of the Institution has agreed to give full support, within the limits of its Charter, to this new organization.' Time does not permit, nor indeed is this the occasion for, an enlargement of this matter. But in the circumstances I have briefly mentioned, it becomes one of the greatest importance and urgency, I submit it behoves every gas engineer from the most influential to the humblest following the Council's lead, to help in shaping the form and policy of the new body, and not to wait to see what may befall."

We duly noted the expressions of high officials of the Ministry of Fuel and Power present at the meeting. No names, no pack drill.

Messages from Overseas

Cable from American Gas Association:

"Greetings and good wishes of the American Gas Association to the Institution of Gas Engineers for a most successful annual general meeting."

Message from Major Alexander Forward, Hon. M.Inst.Gas E. (formerly Managing Director of the American Gas Association):

"Warmest regards to my friends and regret I cannot be with you. I wish you a highly satisfactory meeting."

Cable from Dr. J. G. King (Director, Gas Research Board) and now visiting the United States:

"Best wishes from abroad for a very successful meeting."

Election of Officers

The report of the Scrutineers of the ballot for the election of officers, auditors, and ordinary members of Council was as follows:

President: 1947-48, Dr. Harold Hartley.
Vice-President: 1947-49, Cecil Harry Chester.
Auditors: 1947-48, H. C. Smith and Alfred Morland.
Hon. Secretary: 1947-48, John Terrace.
Ordinary Members of Council: 1947-50, T. C. Battersby, G. E. Currier, Frank Dawson and T. C. Finlayson.

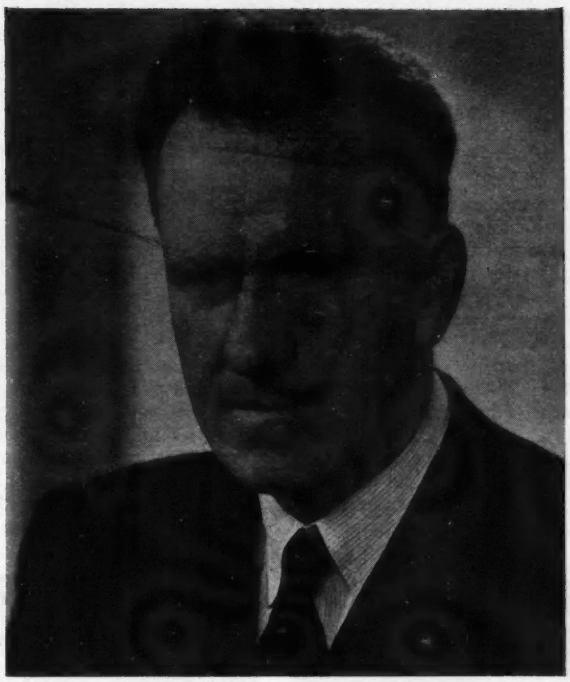
The Scrutineers also reported the election of 11 honorary members; 16 members; 83 associate members; and 10 associates. (See p. 651.)

The election of the following District Members of Council nominated by the District Associations, was also announced:

T. R. Cook (Blackpool)	(Manchester)
O. P. Cronshaw (Rhyl)	Wales and Monmouthshire)
James Dickson (Dundee)	(Waverley)
H. S. Milne (Aberdeen)	(North British)
G. P. Mitchell (Worcester)	(Midland)
F. W. Sansom (Exeter)	(British Junior Gas Associations' Joint Council)
P. J. Sheehan (Cork)	(Irish)
J. M. Webber (Croydon)	(Southern)
R. A. Weston (Norwich)	(Eastern)
F. Wilson (Darlington)	(North of England)

Medallists

Which brought us to one of the high lights of the meeting—the presentation of medals. First came the award of the Birmingham Medal to Sir Frederick J. West; and we think we should mention something concerning this distinguished Medallist. Sir Frederick was born in 1872, a son of John West, who was himself awarded the Birmingham Medal in 1918 and who founded the firm of West's Gas Improvement Company. He was President of the Institution in 1941-42, Chairman of the Society of British Gas Industries in 1910-11. He was Chairman of the Manchester College of Technology in 1921-28, and is an Honorary Associate of the Manchester College of Technology, and a Member of the Court of the University of Manchester. Prominent in public affairs, Sir Frederick became a Councillor of the City of Manchester in 1905, an Alderman in 1920, and Lord Mayor in 1924-25. He was appointed C.B.E. in 1920, Knight Bachelor in 1936, K.B.E. in 1943, and G.B.E. in 1947. He has been President or Chairman of a large variety of engineering Associations or Boards. In 1935, Sir Frederick received the Walton Clark Medal, awarded by the Franklin Institute of the State of Pennsylvania in the United States of America "in consideration of his outstanding service to the Gas Industry in the sphere of improved scientific development of gas-works practice and technique and practical gas research as applied particularly to the carbonization of coal in vertical retorts, and for his work in the training and education of engineers and his success in promoting amicable relationships between employer and employed, all of which have been of substantial value to the Gas Industry."



Dr. Harold Hartley, President of the Institution, 1947-48

The President explained that the Birmingham Medal was initiated in Birmingham in 1881. There was a meeting in Birmingham of the British Gas Managers' Association, which was the forerunner of the Institution of Gas Engineers, and Mr. Charles Hunt, Engineer at Windsor Street, presided. A sub-Committee was formed to arrange for the award of the Medal given for research and the advancement of the knowledge of gas.

Continuing, the President said: "The name of West will not be a fresh name, for in 1918 Sir Frederick West's father was awarded the Medal and you will remember that last year this very Medal was handed to Sir Ernest Smith, Sir Frederick West being good enough to do this in order that Sir Ernest Smith might have a medal as it was not possible to get another made at that time. However, I am pleased to say that on this occasion the gold medal is available."

Sir Frederick West said that this was one of the occasions when mere words were totally inadequate. He was deeply conscious and deeply appreciative of the signal honour conferred on him. "I can assure you," he said, "that I shall regard the Medal not only as a tribute to the work of my firm—in which my brother Ernest and our officials and technicians have all been actively associated—not only because my father was awarded the Medal in 1918, not only because you honoured me with the Presidency of the Institution during one of the war years, rather shall I regard it as a reminder of the co-operation and good fellowship which has always been characteristic of an industry within which it has been my privilege to serve for many years."

The following medals were also presented by the President:

Institution Gold Medal, 1947, to W. Hodkinson and H. B. Taylor for their Paper on "The Development of a Gas Grid," read at the 83rd annual general meeting of the Institution of Gas Engineers in London, in 1946.

H. E. Jones, London Medal, 1946, awarded to F. M. Birks, C.B.E., M.Inst.C.E., M.I.Mech. E., for his Paper on "Roller Carriages for Spirally-Guided Gasholders," read at the 12th Autumn Research Meeting of the Institution.

Institution Bronze Medal, 1946, awarded to C. A. Poulson, M.Inst.Gas E., for his Paper on "Modern Developments in Coal Carbonization," read at a meeting of the Scottish Junior Gas Association (Western District) on Dec. 7, 1946.

Presidential Address

Mr. Pearson then gave his Presidential Address, published in full in our issue to-day, p. 661.

Mr. F. M. Birks, Deputy-Governor of the Gas Light and Coke Company, proposed a vote of thanks to the President. He said: "Mr. Pearson is a distinguished member of the Industry, one whom we all admire and regard for his professional qualities, and one for whom we have the greatest affection in that he possesses that rare quality of being just himself."

Colonel F. J. Bywater, South Metropolitan Gas Company, seconded. In doing so he touched on a personal note, remarking: "I was educated as an engineer at Birmingham as a pupil of one of Mr. Pearson's predecessors, and shortly after I completed my Articles and left Birmingham, Mr. Pearson arrived as a young man at the Saltley Works. Many of his admirers—young men in those days—will rejoice with me at the great success which our young colleague

of those days has since achieved. He has succeeded, and the success is due to those qualities which have found expression in his admirable Address—happier relations with everybody, happier relations with his colleagues and tributes to those who have helped him in his work, particularly the workpeople with whom he has been, and is, in constant contact."

Concerning Germany

This brought us to the first Paper to be presented at the meeting—"Restoration and Control of the Gas Industry in the British Zone of Germany: 1945-47," by Mr. H. D. Greenwood. The Author explained that the first stage of the work of the Gas Section had now been completed. The German Gas Industry is squarely on its feet; nearly all its works are in operations, and the high-pressure grid is in a position to handle all the gas which is likely to be distributed for some years to come. A central German Administration has been established for control and direction of the Industry, and German gas associations (professional, technical, and commercial) have been re-formed. Technical education is well under way and publication of technical periodicals is being resumed.

In the second stage, which opened on Jan. 1 of the current year, British control was limited to matters of general policy, and within this framework the direction of the Industry is entirely in German hands. The Germans are, however, slow to assume responsibility and still refer many problems for advice. British officers inspect at all levels and in all departments to ensure that Military Government policy is being followed. The present policy is more difficult to administer than direct control and needs much patience and forbearance.

The question is sometimes asked: "Since the Gas Industry is an essential public utility, why is it necessary to retain British gas engineers in Germany?" The answer is, broadly, to ensure that the Industry is conducted in accordance with quadripartite policy of which one of the principal objectives is to ensure that the Industry operates to the maximum efficiency and thereby consumes the minimum quantity of coal and other materials which are required for export; the operation of the rationing scheme falls within the same policy.

The German Gas Industry will have many problems in the future which are dependent on the policy of the Occupying Powers. For example, until the future of the Ruhr and its associated problems are settled, the future organization and economics of the grid gas companies, coke ovens, &c., cannot be decided. There will be surplus coke oven capacity, and a considerably greater proportion of the gas now distributed by gas undertakings could be supplied from coke ovens. Rather than rebuild and repair gas-works, it might be more economical to use more coke oven gas and utilize to a greater efficiency the existing grid systems.

The question of nationalization must also be considered. The Germans are divided on this, the extreme Left parties being, of course, strong advocates of nationalization. The German speaks of "socialization," which has a rather different meaning and often implies a joint ownership by State and local authorities and even private enterprise. As most gas undertakings are owned by local authorities, some Germans consider that no further action is necessary. Coke ovens and perhaps the grid companies will probably be associated in whatever scheme is adopted for the ownership and control of the Ruhr collieries.

Another problem for the future will be to decide whether there shall be free and unfettered development of gas consumption for all purposes or whether some limitation will be imposed through coal allocations. In this case the average domestic consumption of those European countries in which gas supply is well developed might be adopted as a standard.

The position regarding industrial gas (coke oven gas) is more complicated. Germany is to be encouraged to develop her "peaceful" industries and to export the products of these industries to balance imports of materials which she is not allowed to produce. Under present policy, definite limits have been laid down for the production of steel, certain chemicals and other products, and some industries (*e.g.*, aluminium) have been prohibited. No industries are yet

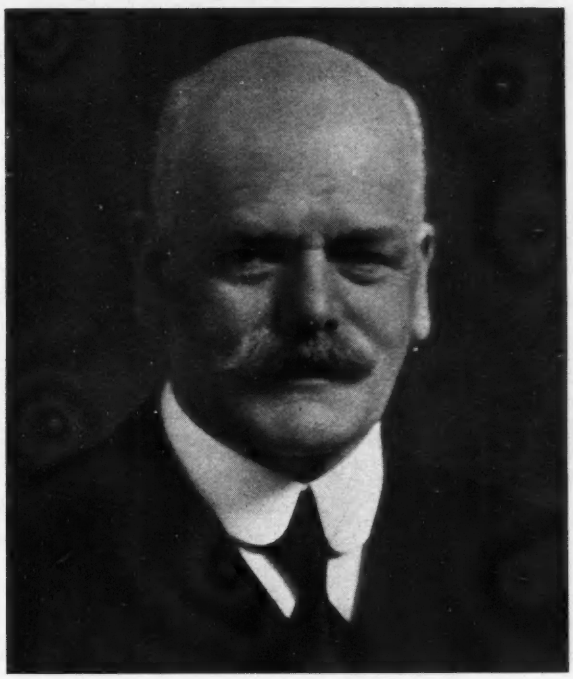
E. Crowther, Senior Vice-President

C. H. Chester, Junior Vice-President

producing to their limiting figure, and gas consumption will increase as their output is raised ; it is anticipated that about 50% more coke oven gas will be required by the end of the present year.

The meeting adjourned, and in the interval was the President's Luncheon at the Botanical Gardens, Edgbaston, a report of which appears elsewhere in this issue. On resumption we had a Paper by Mr. W. L. S. Spinks and A. E. Mason, on "Aspects of Gas Measurement."

The Paper described types of station meter in use on the works of the Birmingham Gas Department and the method adopted to test such meters at a rate of 45,000 cu.ft. per hr. For this purpose a rotary meter and portable fan plant is employed, the rotary meter being tested against a specially calibrated 3,000 cu.ft. holder erected under cover. The periodic testing of station meters is supplemented by a system of regular examination and maintenance. Particulars were given of the method employed for carrying out *in situ* testing of consumers' meters on the district. Consumption of gas for street lighting in Birmingham is computed by using figures obtained from two batteries of check-meters, each supplying gas to one of the types of clock-controlled lamps in use in the city, and the Paper's high-light was explanation of a device for eliminating the auto valve on prepayment meters by substituting an arresting trip mechanism.



Sir Frederick J. West, G.B.E., Birmingham Medallist

On Wednesday morning, June 4, the meeting opened by presentation of a Paper by Mr. A. C. Grant and Mr. M. Noone, on high pressure gasholders. The Authors drew several conclusions, among which are the following: First of all, they said, it is in the best interests of the Gas Industry that no considerations of first cost, storage economics, or local circumstances should be allowed to obscure the necessity for the highest standards in design and construction. To this end it is desirable that there should be close collaboration between gas engineers, designers, and the insurance companies in the drawing up of codes and specifications, particularly during the development period.

We quote from the Paper:—"A properly designed, constructed, and tested riveted holder may be regarded as sound and reliable and in the tradition of steam-boiler practice. The riveted holder is, however, dependent upon the proper driving of rivets, and increasing difficulty is visualized in obtaining the skilled and conscientious craftsmen required. Hand riveting cannot wholly be replaced by power riveting. In consequence, as the trend in steam-boiler practice is towards welded construction, so does this trend seem inevitable in pressure gasholder construction.

"A properly designed, constructed, and tested welded gasholder is an even better engineering structure than a riveted one. The supervision and testing of welding must, however, be rigorous, partly because the detection of bad welding is more difficult than that of bad riveting, and partly because the known imperfections of good riveting can be accepted because of long accumulated experience, whereas the imperfections of ostensibly good welding (a newer technique) cannot.

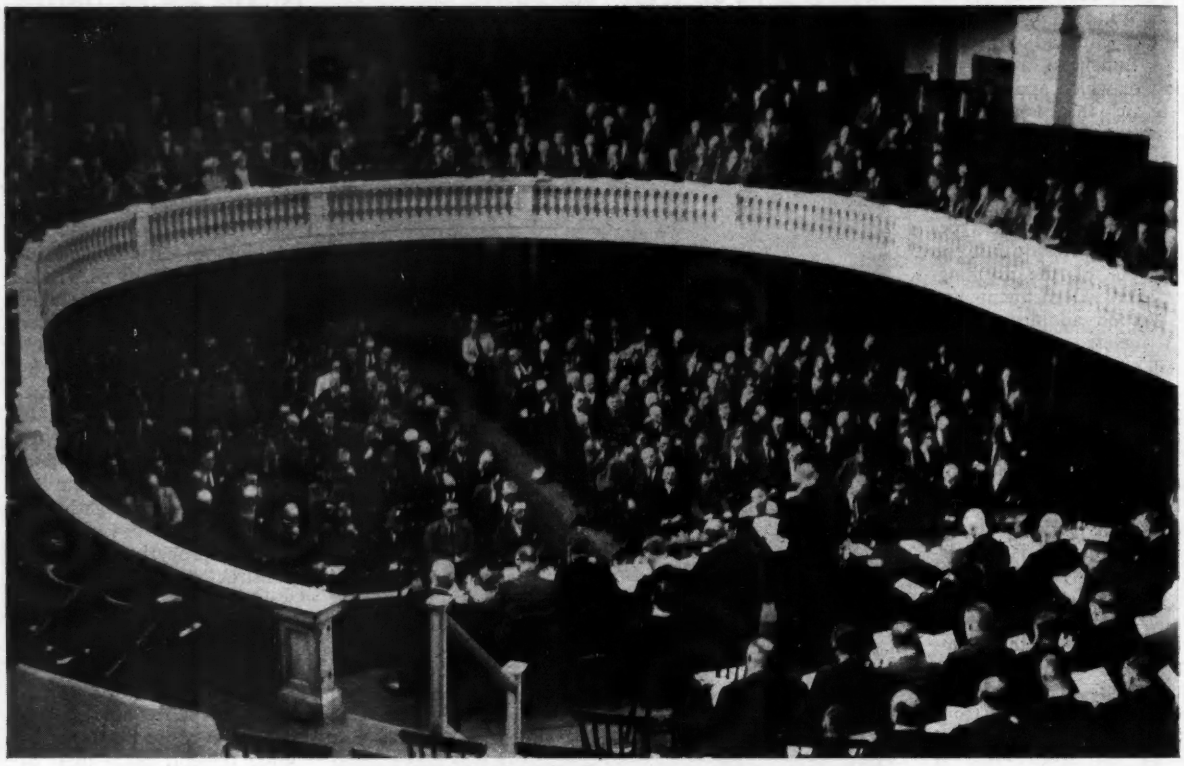
"With the availability of X-ray weld examination there is no need to accept inferentially proved workmanship as has been the case in the past with riveting. As in steam-boiler practice so in pressure gasholder practice the modern alternative to sound riveted construction is X-ray examined, welded construction to the appropriate insurance code.

"For the storage of gas under pressure the suitability and safety of a well-designed, built and proved pressure

F. M. Birks, *H. E. Jones London Medal.*

W. Hodkinson, *H. B. Taylor,* *Institution Gold Medals.*

C. A. Poulson, *Institution Bronze Medal.*



The Opening of the Meeting in the Town Hall.

OUR CAMERA AT THE MEETING

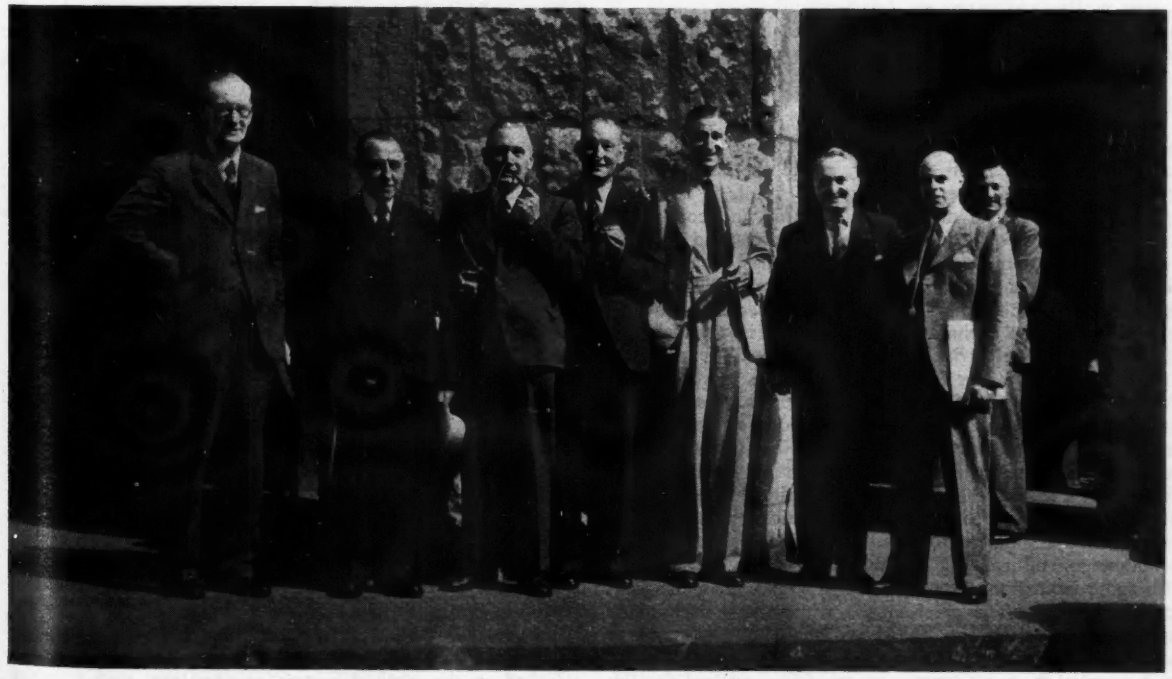
Pictures taken by the "GAS JOURNAL" photographer during the opening session on Tuesday, June 3, and at the President's Luncheon on the same day

Snapped at the Botanical Gardens, left to right, The Lord Mayor of Birmingham, Lord Dukeston, the President, and Dr. Harold Hartley.

In the photo on the right, Mr. F. C. Briggs takes the microphone during the Meeting. Below, Councillor Seymour Brown chats with Mr. E. A. Couzens at the President's Luncheon.

Right, finding M.S. in the Botanical Gardens.

Below in the brilliant sunshine outside the Town Hall, R. Walker, T. Biddulph-Smith, C. H. Davidson, F. J. Siddell, S. Francis, W. F. Rodger, and L. W. Walker pose for our cameraman.



holder cannot be questioned. The Authors hold the view that the choice of construction should lie between riveting and X-ray-proved welding. Given assurance of riveting quality to traditional steam-boiler standards, the selection will be influenced largely by cost and the availability of skilled craftsmen, but nevertheless some weight should be attached to the engineering perfection of good and proved welded joints."

The Benevolent Fund

Following was the General Meeting of the Contributors to the Benevolent Fund of the Institution, and then the Paper by the Director of the Gas Research Board, Dr. J. G. King, on "The Control of Chemical Reactions on a Large Scale."

History—and the Future

The history of the Gas Industry, stated the Author, is a story of steady progress, over a period of almost 150 years, to a present stage of high efficiency, without fundamental change in the main method of production of coal gas. Carbonization by external heating, as introduced by Murdoch, is still the principle of the method by which most of the town gas of to-day is made, although it is true to say that the yield of gas is now augmented by the steam-carbon reaction in the case of continuous vertical retort practice. Throughout this period the chemist has played his part in improving technique, in providing adequate means of process control, and in making possible certain important forward steps, such as those which have taken place in the development of refractory materials and in the marketing of ancillary products of carbonization. He has not, however, yet brought to the stage of manufacture any process of gas making from coal which involves a fundamental change from the conventional method of carbonization.

In the field of chemical industry the chemist has been more successful, in that his academic studies have in several instances grown to the stature of new and important industries. A popular example of this is the plastics industry, which has grown in less than one generation from the work of L. H. Baekeland. A second, and more recent example, is that of the application of catalysts on a large scale. It is not so long ago that catalysts were still in the hands of the research chemist, but now there are few industries in which they do not play some part, and many in which they are all-important.

In most catalytic processes the ratio by weight of raw material to catalyst is large. In the process of the catalytic refining of petroleum oil, however, where the catalyst loses activity quickly and the ratio must be small, it has been necessary to develop a means for the rapid and continuous handling of large quantities of finely divided solid catalyst. The technique of movement of fine solids has been brought to such a stage of perfection in this process that the application of a similar technique to other processes is an obvious development. The technique itself consists in the carrying of finely divided solids in an air or gas borne stream under conditions of fluid flow in which the motive power is provided by static head of solid and/or by gas pressure, and pumping or mechanical handling is avoided. Direct application to other catalytic processes is obviously possible, but indirect application to reactions in which the finely divided solid is one component of a gas-solid reaction is of particular interest in relation to the possible gasification of coal in powdered form. There followed a brief description of the technique of oil refining by fluid-flow catalytic cracking, with some indications of its possible application in the gasification of coal. The chief claims which have been made by oil technologists for the new procedure are:—(*i*) A method for the movement of large tonnages of finely divided solid material in a gas-borne stream; (*ii*) a method for the introduction of heat in mass into a sphere of reaction in order to reach and maintain a desired reaction temperature; (*iii*) a method for the control of gas-solid reactions under conditions of thermal stability and high thermal efficiency.

It is Dr. King's belief that the technique might bring about a fundamental change in certain processes existing in, or of immediate interest to, the British Gas Industry. Application in catalytic processes could be direct, but would, of course, be valuable only for reactions involving a low raw material: catalyst ratio, or the need for frequent reactivation of catalyst. The technique might also be applied to the purification of coal gas from hydrogen sulphide by powdered iron oxide. It is, however, of the greatest interest in connexion with the work of the Gas Research Board on the development of a process of complete gasification of coal involving the synthesis of methane by the action of hydrogen upon coal and the gasification of coal or coke in oxygen and steam, both under pressure.

Electricity in the Gas Industry

The first item on the Thursday morning was a Paper by Mr. G. M. Rimmer, Electrical Engineer to the Birmingham Gas Department. The Paper reviewed broadly the application of electricity to the Gas Industry, the Author believing that much progress could be made in mechanization of the Industry if the problems were really understood and if electric power could be considered as reliable as steam.

Part of the Paper dealt with sources of electric supply: private generation has in some measure fallen into discredit, but its use is now advocated in conjunction with public high-tension supply. This necessarily implies parallel operation of both supplies (which has been looked upon with considerable disfavour by the electric supply industry), and experience has shown that complete unity and flexibility of supply can be obtained and considerable economies effected by this method.

Another section of the Paper dealt with the generation of electric power on gas-works. Choice of supply and voltage was mentioned, but predominance was given to efficient steam operating conditions, as the Author felt that gas-works offer an ideal opportunity for exploiting waste-heat recovery by means of high-pressure steam boilers in conjunction with back-pressure or pass-out turbines. Various operating efficiencies were given in connexion with non-condensing and condensing plant, but working conditions greatly affect the efficiency of steam engines and turbines, and an attempt was made to outline steaming conditions and rating, of engines and turbines, which would lead to higher efficiencies. Figures given for waste-heat recovery were not actual figures, as even with a single plant, said Mr. Rimmer, it is almost impossible to arrive at a complete heat balance; the estimate is, therefore, very approximate and is only included so as to give some idea of the annual fuel saving (it has been stated at 385,000 tons) which could be achieved by the Gas Industry. Utilization of electricity on the works is a problem which should be fully understood by the gas engineer, as it is a much more attractive proposition than steam or gas engines, and with careful application the electric drive can be capable of effecting considerable economies; several examples which have already been carried out are given.

"Distribution of electricity about the works becomes of vital importance, particularly if such important drives as exhausters, boosters, boiler feed-pumps, &c., are to be electrified; the electrical protection of the whole system requires something better than the haphazard installation of overload devices. The provision of protective gear is, however, a specialized branch of electrical engineering, and should be placed in the hands of a competent authority."

Particular attention is given in the Paper to the speed control of electric motors, and considerable importance is attached to the method known as armature control, which

can be applied to alternating-current systems by means of rectifying equipment. An electric motor can be made to "crawl" in a manner exactly similar to the slowing down of a steam engine, and speed control can be imposed giving an infinite variation between zero and maximum, and having a constant torque characteristic which gives an output directly proportional to speed. An example of this is the patent vari-speed drive by the Electric Construction Company, of Wolverhampton, which incorporates either grid or induction regulator control so as to give a variable speed over any desired range. Mechanical details are also of importance, and a brief description was given of the thermal rating of an electric motor.

Electrical control and instrumentation were dealt with, and attention was concentrated on two of the more important items—*i.e.*, functional control by remote operation, and the balanced electronic recorder. The Author feels that more use should be made of remote control, and in the Paper a brief description of a typical supervisory equipment was given.

Among other matters, electrolytic corrosion was discussed and methods were given for the prevention and detection of current leakage. Experience has shown that where leakage recorders have been installed on works plant, there has been very little trouble from this source, and in general the problem is one of locating the cause of any damage that may have occurred. Finally, the all important question of maintenance was discussed.

Mr. A. W. Lee, General Manager of the Birmingham Gas Department.

Education

The final Paper, at the meeting was by Professor Stacey G. Ward, on "Education, Recruitment, and Training of Gas Engineers." Professor Ward came to several conclusions. He submitted that recruitment by the Gas Industry of chemical engineers from the universities will be made easier if attention be paid to the following points:—

Encouraging students to visit gas-works and, on such visits, providing guides who can answer not only questions concerning plant and process, but also questions concerning the exact nature of the work of different employees, especially of graduates, from the youngest on the works to executives.

Giving full information of prospects when interviewing candidates. The usual "prospects, of course, depend entirely upon the way you work" is not a satisfactory reply to a potential recruit. He wants to know the chances of promotion if he works well, what the various posts in the organization for which he may eventually be available are, and an approximate idea of the salary ranges.

Introduction of an organized and well directed course of training for the newcomer.

Introduction of courses at selected technical colleges (or at larger works) for graduates in chemical engineering who wish to extend their knowledge of the principles of gas engineering.

Access to the works library, and opportunity to read textbooks and current technical journals.

Ensuring that there is a sympathetic human attitude, which can be achieved without coddling, to works life, including

(*a*) real interest of immediate superiors and departmental managers in the young graduate's progress and work generally, coupled with constructive criticism, as occasion suggests;

(*b*) dissemination of information concerning plant alterations and extensions, technical policy, &c., so that younger members of the staff feel that they are really part of the organization;

(*c*) recognition of professional values by granting time off occasionally to attend meetings of technical institutions when suitable papers are to be discussed;

(*d*) occasional visits to other works, especially to inspect new plant or new processes;

(*e*) maintenance of discipline coupled with freedom from petty restrictions, and annoyances. No member of staff is so critical of lax discipline or of unnecessary impositons as a graduate fresh from the university;

(*f*) remuneration not less than that applying in parallel cases in other industries not only in the initial stages, but also and particularly in the intermediate stages, before reaching executive status; this is important if the Industry is to secure and retain the services of the best of the students graduating in chemical engineering;

(*g*) revision of certain regulations concerning admission to Corporate Membership, so that graduates in chemical engineering may be allowed concessions similar to those granted to graduates in gas engineering of British universities.

Concluding Proceedings

Mr. T. C. Finlayson said it was his privilege to propose what was usually referred to as an omnibus vote of thanks. "The outstanding success of this the 84th Annual General Meeting of the Institution has only been achieved by the co-operation and hard work of a great many people, and I am sure that they deserve our thanks and that I should mention them by name for inclusion in this vote of thanks. The Lord Mayor and Lady Mayoress of Birmingham, who honoured this Institution by according us a civic welcome and joined our President and his wife in receiving us at the reception.

"The City of Birmingham Corporation and Gas Committee, who on many occasions have been our hosts during this past week, and have demonstrated to us that while the City of Birmingham may be the second in size, it is second to none in efficiency.

"The University of Birmingham, who, by allowing us to hold our reception and dance within the precincts of the

Through these impressive gates came 1,224 Institution members and their ladies to enjoy the Reception and Dance held in the Great Hall of the University at Bournbrook on the Tuesday evening, by invitation of the Birmingham Gas Department. A warm welcome awaited them from the Lord Mayor and Lady Mayoress of Birmingham and the President and Mrs. Pearson. The hospitality they received was in every way exceptional and the occasion will be long-remembered both for the dignity and attractiveness of the surroundings and for the excellence of the arrangements and the obvious care lavished upon them. The lofty hall and spacious accommodation of the University were doubly pleasant in view of the warmth of the evening, and, despite the heat, the music of Vernon Adcock's Aristocrats coaxed many couples on to the floor. Guests were able to enjoy an excellent cabaret and during the course of the evening Mrs. Pearson presented the prizes to the successful members of the S.B.G.I. Golfing Circle.

University have added a new status to the profession of gas engineering.

"The Mayor and Mayoress of Leamington Spa, who kindly entertained our ladies while many of us were engaged in visiting important works.

"The representatives from overseas, who have seen our Industry and our Institution at work and at play.

"The staff of the City of Birmingham Gas Department, whose efforts on our behalf have been tremendous during the meeting, and who must have put in many hours of hard work before we arrived.

"Radiation, Ltd.; Austin Motor Co., Ltd.; General Electric Company; and Dunlop Rubber Company, Ltd.; four great firms who have allowed us to visit their works and who, between them, have entertained many hundreds of guests.

"Ladies and gentlemen assisting in the conduct of the meeting, who have always been at hand to set our feet on the right paths.

"The Authors of Papers, who have provided us with most interesting Papers which have in turn led to a very interesting series of discussions.

"The scrutineers of the ballots, and the officers, auditors, Council, and Committees of the Institution, who give so generously of their time for the work of the Institution.

"Last but not least, the Secretary and Staff of the Institution, who, I am sure we all agree, call for special mention. It is becoming a platitude to say that we expect from Dr. Braunholtz and his staff a perfectly organized Annual Meeting. We may have wondered whether an away match might have shaken their usual play, but the team has batted with its usual consistency and polish, and no one knows now whether they might not suggest a longer professional tour. I, therefore, have very great pleasure in proposing that a vote of thanks be carried to all those who have contributed to the success of the meeting."

Mr. A. Tran: I am deeply conscious of the great responsibility which I have the honour to share with Mr. Finlayson in expressing gratitude of so many to so many for so much. Our visit to this great City will be remembered as one of the really outstanding conferences in the long history of the Institution. Everything possible has been done for our comfort and convenience, and our entertainment and education. I know I may be forgiven if I make special reference to the Birmingham Corporation Gas Department who have been so largely responsible for the success of our meeting. If the energy, enthusiasm, and administrative ability which they have devoted to the planning of our conference is an example of the way the civic affairs of this City are conducted it is little wonder that Birmingham claims a second place in the Empire, a position which I must remind you was held with great pride by Glasgow for so many years.

Dr. W. T. K. Braunholtz (Secretary): I am grateful to you for allowing me one minute of the time of this meeting, and I think you will forgive me for asking for the privilege of saying one or two things which I do feel should be said before we break up. In the first place I am sincerely grateful for the very kind vote of thanks that has been passed in so far as it relates to the staff of the Institution and myself. I should indeed wish to join myself in that vote of thanks to my staff, because they have worked with the greatest enthusiasm and quite tirelessly throughout the past days and weeks and months in order to help to make this meeting a success.

Dr. Harold Hartley: I have two duties to perform; the first is pleasant and the second is unpleasant. My pleasing duty is to thank our President for the service he has rendered to the Institution during the past year, and to express gratitude for the fact that, as Honorary Member of the Council, he will continue those services. His quiet personality has endeared him to all his friends, while his wide engineering experience and his mature judgment command the respect of us all. Reference has been made to the work he has done in co-operation with Dr. Braunholtz and his staff in the organization of this obviously highly successful annual meeting, and I want to ask him to accept the thanks of all the members.

At the beginning of his year of office a President must feel that in his senior Vice-President he has a supporter in the background, but as the year draws to a close the senior Vice-President gradually assumes something of the rôle of the Lord High Executioner. Inexorably he draws nearer, and the axe is about to fall, and it is in something of that atmosphere that I now present our President with the Presidential Certificate.

The President: I wish to thank Dr. Hartley for the very kind way in which he has handed me this certificate and for his kind words about my year of office. The feature of my year of office has been the way the City of Birmingham has stood by me and the Institution during Institution Week. The General Manager of the Gas Department and the staff have been most helpful, and the Chairman and members of the Gas Committee have been generous in their acceptance of the work which I have been able to do.

New Members

The following Honorary Members, Members, Associate Members, and Associates were elected as the result of the ballots declared at the opening session:

HONORARY MEMBERS (11)

The Presidents (*ex-officio*) of the Gas Associations of Australia, Belgium, Canada, Denmark, France, The Netherlands, New Zealand, Norway, Sweden, Switzerland, and United States of America.

MEMBERS (16)

Cordiner, J. (Aberdeen).
Gardner, J. (Sheffield).
Harris, R. (Leeds).
Jones, E., B.Sc. (Rhondda).
Jones, L. V. (Société Anonyme du Gaz, Rio de Janeiro).
King, A. D. (Bo'ness).
Nave, G. M., M.Sc., F.R.I.C. (Consett Iron Co., Ltd.).
Oliver, G. F. (Swindon).
Palmer, W. T. (Samuel Cutler and Sons, Ltd.).
Pemberton, K. G. (Devon Gas Association).
Pressley, C. D. (Dover).
Royden, G. A. (Greenock).
Stott, C., M.C., B.Sc. (South Metropolitan).
Tallentire, T. L. (Dursley).
Williams, J. H. (Nottingham).
Wyatt, G. D., A.M.I.C.E. (Gas Light).

ASSOCIATE MEMBERS (83)

Abley, A. F. J. (Shotley Bridge and Consett).
Alsop, C. J. (Northampton).
Ardron, E. (Ely).
Ashton, J. E. (Manchester).
Bain, J. (Wandsworth).
Ball, E. (Wandsworth).
Bateman, M. H. (Clayton, Son & Co., Ltd.).
Bispham, T., B.Sc., A.R.I.C. (Gas Light).
Black, G. H. (Barnsley District Coking Co., Ltd.).
Briggs, W. A. (Newcastle-upon-Tyne).
Chignell, P. A. (Severn Valley).
Clark, J. E. (Sunderland).
Clayfield, J. A. (Swindon).
Cockayne, G. W. F. (Rugby).
Cox, C. P. N. (Gas Light).
Crane, K. J. (Shrewsbury).
Dancy, L. H. (Tottenham).
Dawson, F. (Leyland).
Dearnley, H. (Leeds).
Elgin, D. C. (Buxton).
Ellis, F. C. (Torquay and Paignton).
Forbes, P. C. (Tottenham).
Garthwaite, A. (Nottingham).
Gayler, R. (Clacton).
Goodman, J. E. (Gas Light).
Graham, K. S. (Glasgow).
Grounds, F. W. (Chorley).
Grundy, J. M., B.Sc. (Derby).
Harvey, F. (Gas Light).
Hatfield, J. (W. C. Holmes & Co., Ltd.).
Hawes, J. M. (Humphreys and Glasgow, Ltd.).
Hayes, C. W. A. (Lea Bridge).
Hayes, R. (Coventry).
Healey, F. J. (Bournemouth).
Henderson, N. (Darlington).
Henrys, R. E. H. (Gas Light).
Hinshaw, D. (Newcastle-upon-Tyne).
Hoyle, G. (West Riding Group).
Hull, M. F. (Woodall-Duckham Co., Ltd.).
Hutton, J. A. D. (Gas Light).
Jackson, T. W. (Bournemouth).
Judd, S. (Tottenham).
Kerr, F. B. (Elgin).
Lamb, J. E. (St. Helens).
Lock, H. W. (Exmouth).
Magson, J. H. H. (Peterborough).
Martin, J. A. (Redditch).
Maunder, D. J. (Torquay and Paington).
Moore, C. G. E. (Tottenham).
Muller, S. B.Sc., A.M.I.C.E. (Gas Light).
Nelson, S. N. P. (Middlesbrough).
New, W. (Plymouth and Stonehouse).
Newman, R. J. (Gas Light).
O'Neill, R. H. (Newcastle-upon-Tyne).
Pawley, R. F. D. (Plymouth).
Peters, K. G. (Gas Light).
Phillips, A. L. (South Metropolitan).
Raine, J. W., B.Sc. (Darlington).
Ransom, J. C. C., B.Sc. (Brotherton & Co., Ltd.).
Richardson, P. G. (Plymouth and Stonehouse).
Robinson, R. L. (Coventry).
Saggers, R. F. E. (Tottenham).
Salusbury, R. C. W. T. (Gas Light).
Seager, A. C. (Gas Light).
Smith, L. W. (Batley).
Smith, R. L. (Dunstable).
Spalding, T. G., B.A. (Gas Light).
Summersgill, K., B.Sc. (Leyland).
Sweeting, K. J. (Farnham).
Taylor, C. L. (Jones Gas Process Co., Ltd.).
Taylor, N. A. (Derby).
Targett, H. (Gas Light).
Thomas, D. (Oldbury).
Topley, D. H., B.Sc. (Eng.) (British Gas Light).
West, C. E. C. (South Metropolitan).
West, S. A. (Bradford).
Wheeler, R. F. (Tottenham).
Whitney, W. E. (Clevedon and Yatton).
Willis, A. J. (West's Gas Improvement Co., Ltd.).
Winsor, R. J. (Weston-super-Mare).
Wood, G. W. (West's Gas Improvement Co., Ltd.).
Wood, J. (Severn Valley).
Yates, A. (Leamington).

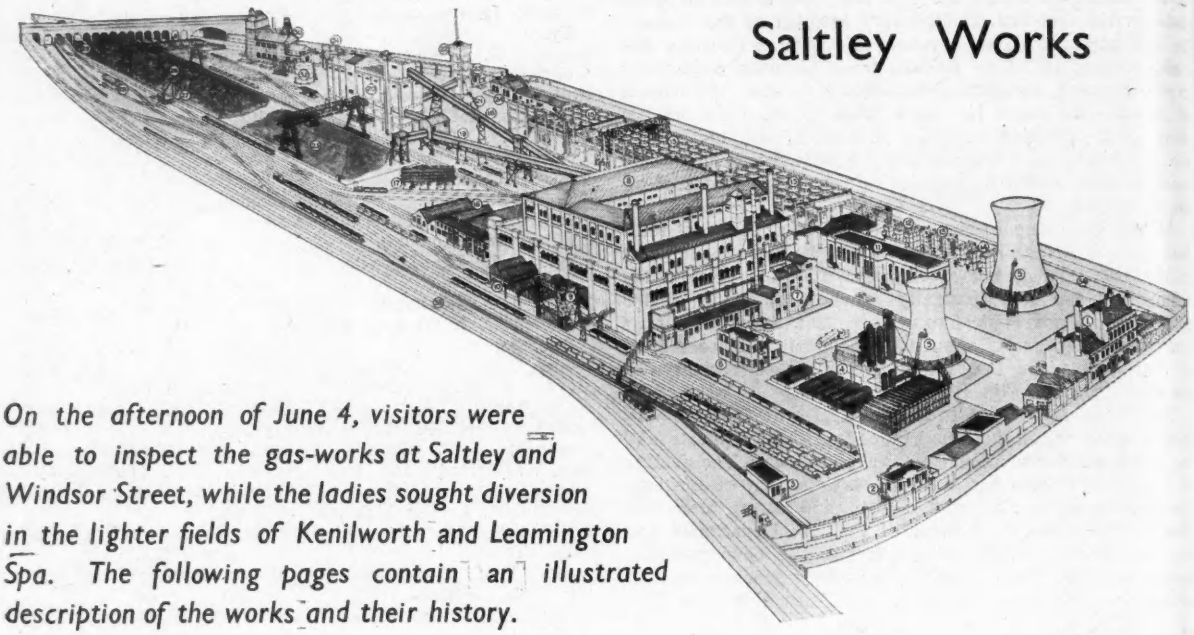
ASSOCIATES (10)

Clifford, F. (Whittaker Ellis, Ltd.).
Eden, E. W. (W. J. Jenkins & Co., Ltd.).
Gostelow, R. R., B.Sc. (Eng.) (Wandsworth).
Mortimer, K. R. (March).
Stansfield, F. (Clayton, Son & Co., Ltd.).
Stubbs, A. W. (Mid-Southern Utility).
Taylor, W. W. G. (Public Utilities Branch, Control Commission for Germany).
Thurston, H. K. (Newcastle-upon-Tyne).
Voice, E. W., B.Sc. (British Iron and Steel Research Assoication).
Winter, A. J. (Leeds).

The Secretary, Dr. W. T. K. Braunholtz

Institution Visits:

Saltley Works



On the afternoon of June 4, visitors were able to inspect the gas-works at Saltley and Windsor Street, while the ladies sought diversion in the lighter fields of Kenilworth and Leamington Spa. The following pages contain an illustrated description of the works and their history.

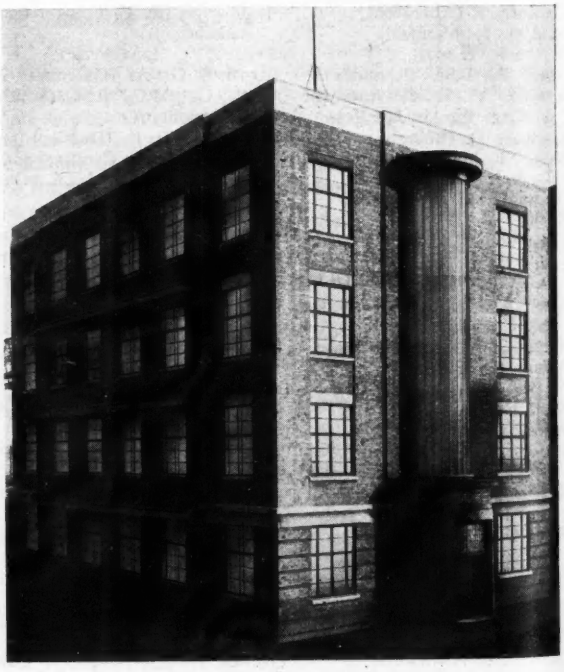
Until 1926 Saltley Gas-Works consisted of a battery of coke ovens making about 7 million cu.ft. of gas per day, also an absolete section of inclined retorts. The inclines were dismantled and for various reasons the coke ovens were shut down in 1928, and replaced by a range of continuous verticals of seven million cu.ft. per day, constructed in the inclined retort house. By 1940, as the departmental outputs of gas demanded extra carbonizing capacity, it was decided to increase the plant at Saltley. However, a difficulty presented itself, as ancillary plant had been added to from time to time, and was largely out of date and of inadequate capacity—in addition to this all but dry purification plant preceded the exhauster. It was finally decided to extend by 9 or 10 millions per day of continuous vertical retorts, and to completely reconstruct the works on modern lines.

There were on the old works four gasholders initially, with a combined capacity of 4½ million cu.ft., and to afford room for a well laid out new works, it was decided to abandon these holders and fill the gasholder tanks, although one of them was retained as a tar and liquor well. This latter, incidentally, gives the new works a storage capacity of three to four weeks' tar and liquor production and is very useful to the whole department in times of emergency. The tank is covered over and the railway passes over the tank. It was arranged for the gas made from the works to be delivered to the Washwood Heath gasholders, a mile away.

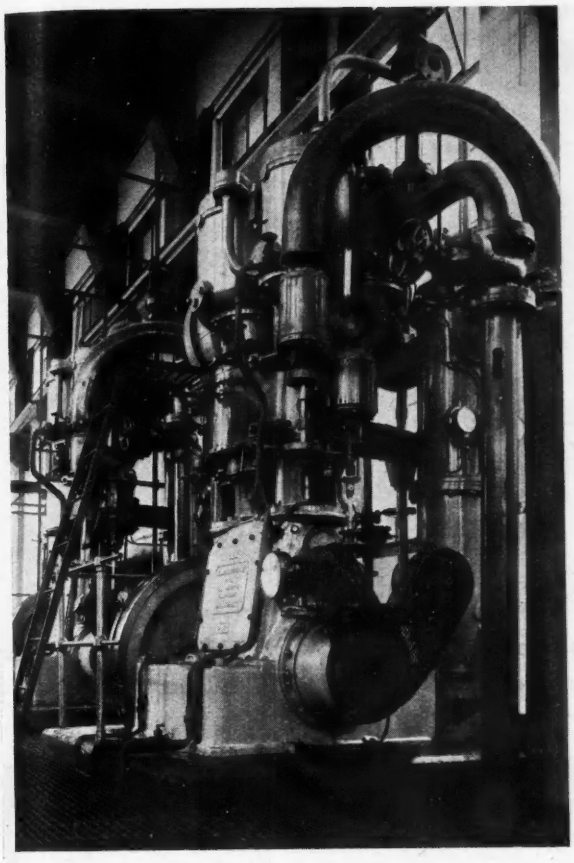
In the reconstruction of the works, a combined exhauster, meter, and power house was built, to contain all the prominent power units of the works, and is a building 144 ft. long by 36 ft. wide. The main power is transmitted electrically and there are two 400 Kw. generators parallelled with the City supply. Primary condensers and tar precipitation plant precede the exhauster and all the wet purification is arranged after the exhauster, followed by the dry purification boxes arranged elevated on a substructure. Coke is removed from the retort house chiefly by belt and is collected by another belt outside the retort house, which runs to the screening plant adjacent to and convenient to the entrance to the works.

A combined stacking ground has been provided for coal and coke, commanded by two Goliath cranes and arranged in continuity, and a movable barrier between coal and coke is provided to give stacking capacities of either to suit current market conditions. Approximately 38,000 tons of coal and 6,000 tons of coke can be stored. The railway wagon accommodation has been increased by 430 wagons, and the shunting facilities have been vastly improved. The sidings are arranged on straight lines instead of the sharp curves previously existing. A water gas plant of three million cu.ft. per day capacity has been added since the works was completed and carburetted water gas is admitted at the inlet to the tar precipitation plant, thus giving a splendid opportunity for the two streams to mix in the purifying plant and allowing variations in quality between water gas and coal gas as may suit manufacture.

A feature of the works is a tar macadam main road 20-30 ft. in width, drained and curbed in all its length, allowing splendid facilities for road transport through the works. The works is complete with benzole extraction and distillation plant, and water softening plant. The total productive capacity is now 19 million cu.ft. per day.



The New Central Laboratory



Left, the air Compressors, and, right, the exhausters at Saltley.

Windsor Street Works

The Birmingham Gas Department dates from 1875, when the Corporation acquired two gas undertakings whose areas of supply considerably exceeded the City boundaries at that time. These were the Birmingham and Staffordshire Gas Light Company and the Birmingham Gas Light and Coke Company. The Windsor Street Works were owned by the latter and since that time have progressed until they are the largest municipally-owned gas-works in the country.

Two Presidents of the Institution have been Engineer of the Works—Mr. Charles Hunt, who retired in 1904, and Mr. George Pearson, who was Engineer from 1919 to 1936, and many of the outstanding features are a direct result of their planning.

The present productive capacity is about 24 million cu.ft. of coal gas and about 8 million cu.ft. of carburetted water gas per day, and the total area is about 26 acres.

Two main entrances—one at Windsor Street and one at Avenue Road—are connected by a good road through the works. The main offices and stores are at Windsor Street and a well equipped laboratory is centrally situated. The site is somewhat congested and the works levels vary by approximately 25 ft. This latter fact has been used to advantage by the provision of approximately one mile of railway viaducts at a height of 20 ft., in addition to 2½ miles of works railways. These viaducts serve the coaling plant in the retort house, the coke screening plant, the coking arrangements on the water gas plant and the coal stacking grounds.

In regard to the general arrangements on the works, the policy has always been to install the most modern plant to meet increasing demands, and as a consequence, many of the items of plant have, in their time, been pioneer installations on a very substantial scale—*e.g.*, the first large installation of continuous vertical retorts in 1912, the first turbo-exhauster, the first static ammonia washers, the distribution of high pressure gas in 1909, and so forth.

Carbonizing Plant

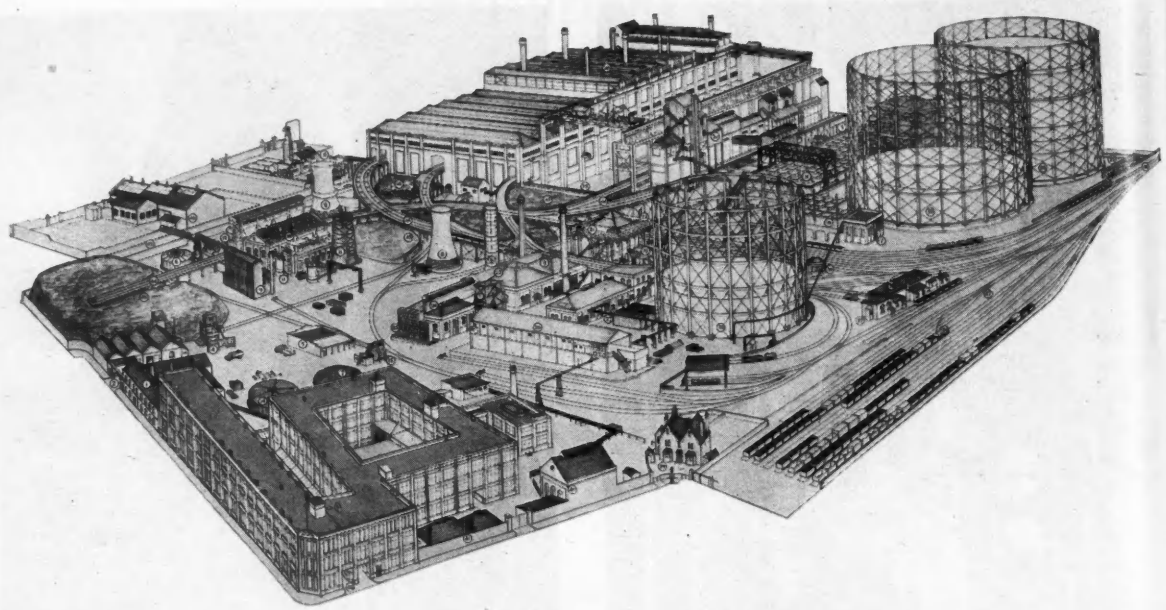
The retort house is 487 ft. long by 210 ft. wide and was originally designed in 1881 to accommodate six ranges of horizontal retorts producing 8 million cu.ft. of gas per day. Two ranges of continuous vertical retorts were introduced in 1912 and progressive additions were made until 1919 when the horizontals finally disappeared.

At the present time there are four ranges of continuous vertical retorts with nominal capacities of 5.7, 6, 7, and 10 tons of coal per retort per day and with a total gas production of approximately 24 million cu.ft. per day.

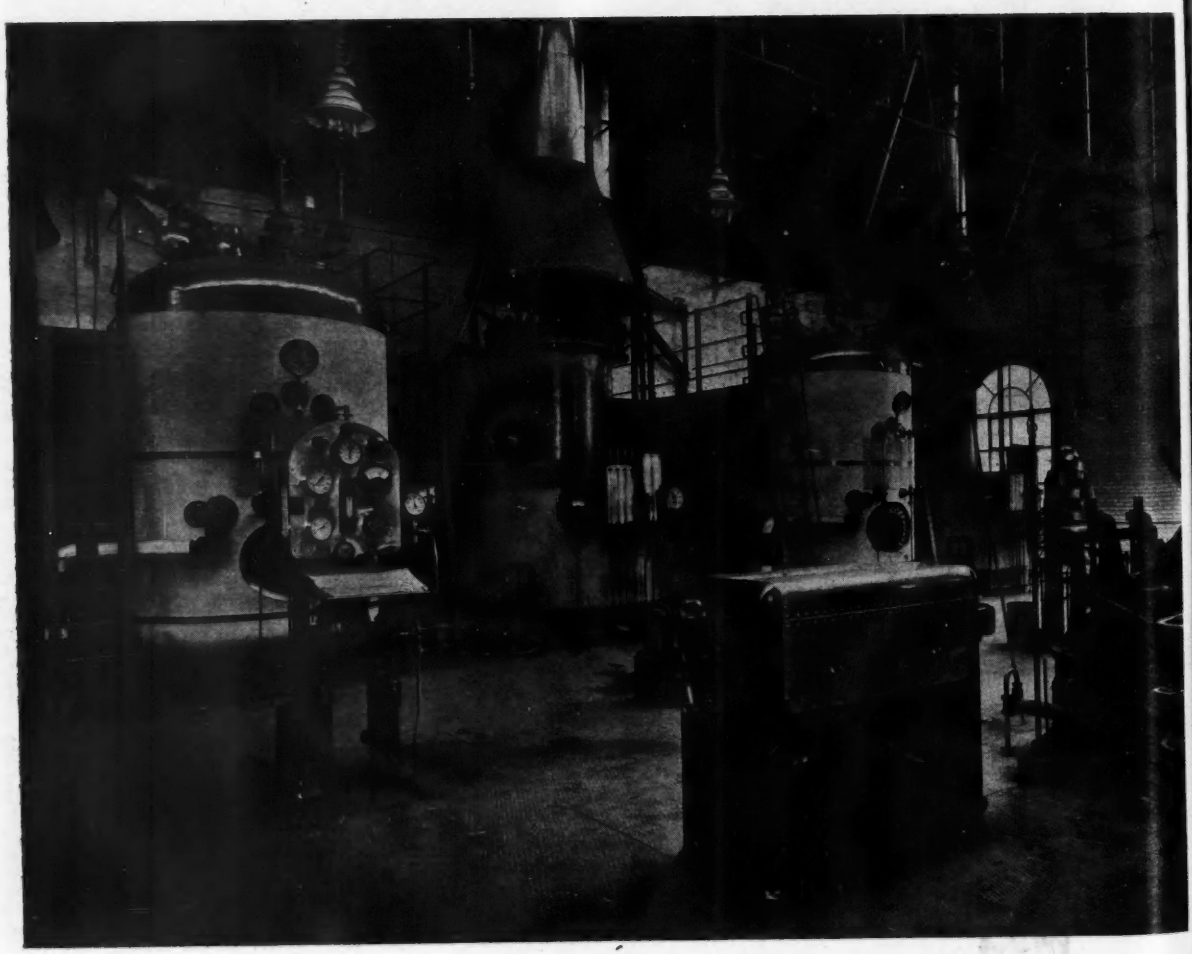
In view of the size of the carbonizing plant, it was impossible to assess the efficiency of any unit and accordingly a Testing Works has been provided, capable of dealing with 3 million cu.ft. of gas per day. Representative sections can be isolated by special foul mains and the products measured and evaluated. The test plant includes the following: Cyclone tar extractor, Holmes condenser, Bryan Donkin turbo exhauster, Livesey washer, and a meter specially constructed for crude gas. There is a laboratory on the site and all the chemical and physical characteristics are recorded.

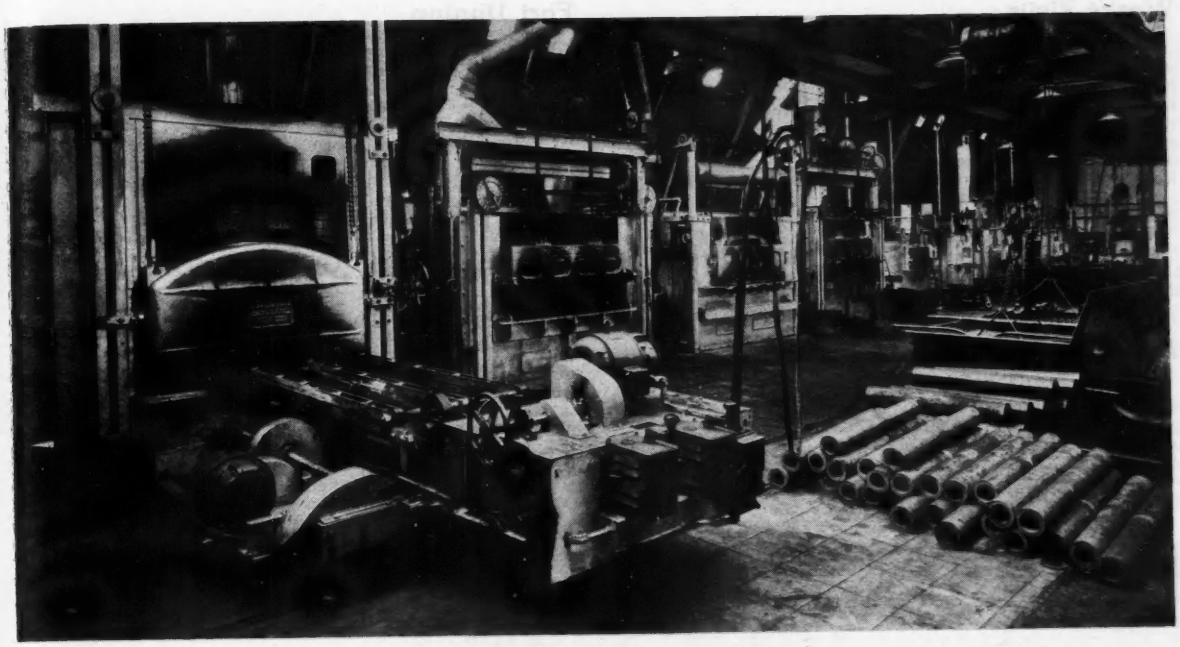
Coal to the retort house is emptied from wagons at a rate of 100 tons per hour, either by an electric rotary tippler or hydraulic end tipping rams, into receiving hoppers, and thence via coal crushers into gravity bucket conveyors running the length of the house. These in turn feed one of three gravity bucket elevators (in duplicate) serving the appropriate ranges. From the elevators the coal is transferred to tipping tray conveyors and thence to selected positions in the bunkers. The total length of the conveyors described is about three-quarters of a mile.

Coke is removed from the retort house by means of 3-ton capacity skips conveyed upon battery driven chassis, each run-



The layout of the Windsor Street Works is shown in the drawing above, while the photograph below depicts the carburetted water-gas plant, which has a daily capacity of 9 million cu. ft.





An impressive view of the Heat Treatment Shop

ning under a line of retorts. The coke skips are elevated from their chassis by overhead travelling cranes and automatically discharged through bottom doors into the coke receiving hoppers on the screening plant. The cranes are 10-ton capacity, 74 ft. span, and travel longitudinally on a ferro-concrete gantry 60 ft. high. They also command the coke stacking ground.

Coke is delivered by mechanical apron feeds from the concrete receiving hoppers to four Gyrex vibratory main screens. Large and small coke are immediately separated. Large coke is delivered direct into trucks or bunkers for bagging or yard sales, domestic small coke is carried by band conveyors to the bag trade section, and industrial small coke is taken for yard and truck sales. Unscreened breeze is conveyed to secondary screens, the dust removed, and separated into one-inch and bean breeze. Either size can be washed in a Coulson washer.

Any size of coke can be taken from the storage bunkers via belt conveyors to the retort house for producer fuel. Domestic small coke and one-inch breeze are sold in bags from Avery 1 cwt. automatic weighing machines; ¼ cwt. automatic weighing machines are installed at the works gates to deal with the demand for loose ½ cwt. of coke.

The crude gas leaving the retorts is conveyed to five cyclone tar extractors, followed by five Piggott water cooled condensers.

Part of the hot water leaving the condensers is supplied to the water softening plant and the remainder circulates through a cooling system and is re-used. Final gas cooling in the condensers is effected by well water under Foxboro' automatic control.

The gas then passes through electrostatic detarrers (by Lodge-Cottrell) to the exhausters. There are three of these machines—one by B.T.H. (capacity 1½ million cu.ft. per hour), one by Bryan Donkin (capacity 1¼ million cu.ft. per hour) and one by Reavell's (capacity ¾ million cu.ft. per hour).

The gas stream continues through the secondary condensers, the static ammonia washers, and thence to the purifiers. There are six sets of the last-named, each set consisting of six boxes. All the handling of new oxide is by crane and grab or electric telpher. The crane is 112 ft. span Goliath type and commands the full area of four sets. Spent oxide is removed through bottom doors and removed by battery driven trucks.

The purified gas is then washed for benzole. The plant was installed during the war, and while the static washers are located on the works, the vacuum stills are placed on an isolated site. This was adopted as an air raid precaution.

There are three holders with a total storage capacity of 17,500,000 cu.ft. and boosters are installed to augment the pressure thrown by the holders.

For the supply of high pressure gas to the city and for augmenting the low pressure distribution system, there are three Belliss & Morcom two-crank single stage vertical steam driven gas compressors with a total capacity of 750,000 cu.ft. per hour and one turbine driven rotary compressor with a capacity of 600,000 cu.ft. per hour. Pressure is varied from 12 to 20 lb. per sq.in. in accordance with requirements.

Works water is obtained from three boreholes with a total capacity of 60,000 gallons per hour.

Electric current is generated by two 1,000 kW generators and a stand-by service from the grid of 1,500 kW capacity is provided to deal with approximately 400 motors. These generators run in parallel with the grid and surplus electric energy is exported to the Electric Supply Department's mains.

The carburetted water gas plant consists of three Humphreys & Glasgow machines, fully automatic, capacity three million cu.ft. per day each. There are three exhausters—one of the Connersville type by Holmes and two B.T.H. turbo exhausters each capable of dealing with full production.

Tar removal is by electrostatic detarrers and the water gas purifiers are equipped for the mechanical handling of new and spent oxide.

General statistics are as follows:—

Men	500-700.
Storage for coal	60,000 tons.
„ „ coke	3,000 tons.
Coal carbonized	800 tons per day, summer.
	1,500 tons per day, winter.
Gas oil storage	900,000 gallons.

Swan Village Works were not visited. This is no reflection on its importance, but its isolated position and particular function of serving chiefly Wednesbury and Darlaston give it quite a different character. Were this not invidious to the rest, one might call it the Cinderella among the works. Total daily output is 5,000,000 cu.ft. of coal-gas from two ranges of vertical retorts, and 2,000,000 cu.ft. of water gas from two hand-operated machines.

A complete new works is to be built nearby. Entirely electrified, this will have a daily capacity of 8,500,000 cu.ft. of coal gas. Power will be generated in turbo-alternators from high-pressure steam from the waste-heat boilers alone, so that no fuel-fired boilers will be required.

TABLE OF STATISTICS.

DAILY MANUFACTURING CAPACITY.

	Coal Gas	Water Gas	Total
	(Million cu.ft.)		
Windsor Street	23	9½	32
Nechells	*21	14½	35½
Saltley	16	3	19
Swan Village	5	2	7
	65	29	93½

* Includes new plant in course of erection.

Works Visits

The visit to the Windsor Street Works and the Lord Street Depot —which houses the main stores of the fittings department, meter repair shops and testing room, stove repair shops, and the offices of the distribution and fittings departments, new building and maintenance sections, drawing offices, and conference hall—was followed by tea in the conference hall, presided over by Alderman E. Pardoe, Chairman of the Works Sub-Committee. Thanks were voiced by Mr. R. J. Rogers to the Gas Committee and all who had helped to make the visit so pleasurable. Alderman Pardoe, in response, said that the Birmingham Gas Department was always happy to play the part of a "big brother" and it was in that spirit that they faced the future, confident that the Industry would rise to the tasks ahead and uphold the traditions of the profession and the Institution to which they belonged.

Austin Motor Works

A very interesting afternoon was spent at the Longbridge Works of the Austin Motor Co., Ltd. The Austin Company is undoubtedly producing an enormous output, and it was a little peeving to see cars coming off the assembly lines all marked "for export," including many with left-hand drives. Spare parts that are almost unobtainable were piled up in heaps of thousands. The works are exceptionally spacious and well laid out.

Fort Dunlop

On the Thursday afternoon a large gathering of members and friends visited the Fort Dunlop Works of the Dunlop Rubber Co., Ltd. The particular section visited is engaged in the manufacture of car tyres and tubes and it was enlightening to see the number of processes necessary before a piece of raw rubber becomes a tyre or tube. A visit was also paid to the test house, where special machinery, designed by the Dunlop Company, is in operation. Visitors finally made their way to the Dining Club, where tea was provided and a vote of thanks was proposed by Mr. C. H. Chester (Swindon). Mr. F. G. W. King, Technical Director, replied.

General Electric Company

It was appropriate that the visit to the engineering works of the General Electric Company at Witton should follow the presentation earlier in the day of a Paper on "Electricity in the Gas Industry." The G.E.C. is the largest British electrical manufacturing organization in the Empire and provides employment for 30,000 staff and workpeople, and Witton is the Company's largest manufacturing centre. The inspection included the manufacture of generators, motors, switchgear, transformers, turbo-alternators, vacuum cleaners, polishers, hair dryers, and other equipment, and a visit to the high tension testing laboratory, where a brief demonstration of a 2,000,000 volt discharge was given. After the tour Dr. C. C. Garrard, Director, presided at tea in the works dining room at the Magnet Club, and in welcoming the visitors he spoke of their common interest in striving for ever-increasing efficiency in the use of fuel. Their two industries were vitally interested in research and development work, and if they both continued to apply the advances of science for the benefit of mankind there was no reason to doubt the prosperity of the country and the world at large. Mr. B. Dawkins expressed thanks to the Chairman, Directors, and officials of the Company, and his sentiments were endorsed by Mr. J. L. Durkin, Mayor of Lancaster.

We envied our cameraman on the Tuesday afternoon when, as the members were sweltering in the heat of the City, he accompanied the ladies on their visit to Lickey Hills, where these photographs were taken.

The Ruins of Kenilworth

Warwickshire Visited

While members of the Institution of Gas Engineers and their wives were in Birmingham for the Annual General Meeting they were able to enjoy several delightful outings. One of these was a visit paid by the ladies to Kenilworth Castle and Leamington Spa. Kenilworth was the first, where they left the motor coaches and walked round the famous castle immortalized by Sir Walter Scott, but now standing in desolate ruins in the midst of green meadows. The coaches then proceeded to Leamington Spa, reputed " the fairest modern town in Warwickshire and one of the finest in England," where the ladies were received by the Mayoress and the Deputy Mayor, and entertained at tea in the Town Hall.

Reception by the Mayor

The Deputy Mayor apologized for the unavoidable absence of the Mayor, but said that he and the Mayoress warmly welcomed the ladies to Leamington. He was particularly pleased to know that with the party were delegates from Holland and Switzerland, as it was undoubtedly of great value to the Gas Industry to have international participation in their meetings. For his part, he was delighted that representatives from these countries could be given the opportunity to see his beautiful town, of which Warwickshire was, justifiably, so proud, and which was, in its turn, proud of the magnificent service rendered by its Gas Department.

Time did not permit a tour of the town, but after tea the party was given an opportunity to walk through the famous Jephson Gardens, known as the most beautiful ornamental gardens in Britain, with fountains in replica of those at Hampton Court. The ladies were fortunate in having blue sky and warm sunshine for this expedition, which greatly enhanced the charm of the surroundings.

Theatre Evening

The next evening members and ladies visited the Birmingham Repertory Theatre, founded by Sir Barry Jackson in 1913, to see a performance of " The Thunderbolt," by Sir Arthur Pinero. This was greatly appreciated, as was also the Theatre Dinner at Kunzle's Restaurant which followed this well-acted play.

The next and most memorable of the expeditions so ably organized for Institution Week was a day spent visiting the Shakespeare Country though unfortunately for this the weather was not so kind.

Warwick

After an early start, Warwick Castle was visited and more than an hour spent in viewing the interior of the Castle and its many treasures, accompanied by an excellent guide. A short visit, all that time permitted, to the Italian Garden was fortunately taken during a brief interval of sunshine; unfortunately this was not the case with the well-known beauty spot Guy's Cliffe. Here the lake and the ancient water mill so often depicted by artists were seen, with the impressive old mansion in the background, built by Guy, Earl of Warwick.

This beautiful old county town epitomizes the charm of Warwickshire, and it is fitting that in a region so typically English there should be one of the finest mediaeval castles in the country, poised over the River Avon and rising sheerly from it. Here again the party could recall Sir Walter Scott, who called it " that fairest monument of ancient and chivalrous splendour which yet remains uninjured by time," and that was found still to apply, with the antique treasures in its rooms (not the least fascinating of these, Queen Elizabeth's own handkerchief) and the splendid peacocks strutting about its grounds. Housed in these grounds, too, members were able to inspect the famous Warwick Vase, twenty-two centuries old and as high as a man.

From Warwick it was interesting to catch another glimpse of Kenilworth Castle in the distance, and it was regretted that this was not in the same beautiful state of preservation.

Welcome in the Memorial Theatre

When the party reached Stratford-upon-Avon, they were received in the Conference Hall of the Memorial Theatre and given a cordial welcome by the Mayor, who said he was delighted to extend this to the members of the Institution of Gas Engineers and their ladies. The citizens of Stratford were justly proud, he said, of their ancient borough and the treasures which the visitors would see that afternoon. The borough was incorporated in 1553, but he was glad to say that their excellent Gas Department was not quite so old, and under the expert guidance of Mr. D. K. Green they expected greatly to improve it. On behalf of the whole town he would like to say that the I.G.E. was very welcome to Stratford.

After luncheon, Mr. J. H. Bird, a local historian and authority on the Shakespearean relics of the town, gave a talk on Stratford-upon-Avon and the surrounding country, which proved of great value to the

(*Continued on page* 660)

The Birmingham Works and Laboratories of Radiation Ltd.

ON Wednesday, June 4, some 252 institution members and friends made a most interesting tour of the Birmingham Works and Laboratories of Radiation Ltd., and saw how much care and research go into the making of New World gas appliances.

In the foundry, which is completely mechanized, sand is conveyed to the moulders, and the moulds are removed by conveyor for casting, cooling, and knocking out. The sand is then recon-

Cores prepared by women who neatly pack the sand and linseed oil into box moulds prior to their transfer to shells for drying in gas heated ovens.

ditioned and used again. Molten metal from the cupolas, each capable of melting five to six tons per hour, is taken by bogies to the casting platforms and poured into the moulds from hand ladles. Test bars of every melt are taken for analysis to ensure that the iron is of the right quality for vitreous enamelling. Dressing of the castings is done in several ways and after inspection they are directed to the various departments.

The quiet of the core shop was most pleasant after the foundry noise, and here we saw cores made both by hand and by machine. The latter method is a great aid to production speed-up, being some five times quicker than the hand method. The cores are placed on shelves and pass around a hot chamber at a temperature of 500°F for drying out. They are then dressed and inspected and passed to the moulding areas.

A quick visit to the pattern shop showed us the up-to-date plant necessary for working to the extremely fine limits required for interchangeability. First comes the wood or plaster pattern, followed by lead casting, iron original, and finally the plate pattern. Some 10,000 pattern plates are housed in racks in the pattern stores and a complete catalogue is kept for quick reference.

The inspection department is chiefly concerned with the checking of the Regulo and brasswork for cookers, fires, &c., and every Regulo is dismantled, cleaned, inspected, assembled, numbered, and passed on for calibration. After setting it is sealed and is tested under water at a pressure of 5 lb. per sq. in. Taps, injectors, governors, &c., are all subjected to most careful checking before being passed to the stores.

On the upper assembly floor two conveyors are in operation producing cookers of an immediate post-war design, while on the lower floor production has started on a new model known as the 1430 Series.

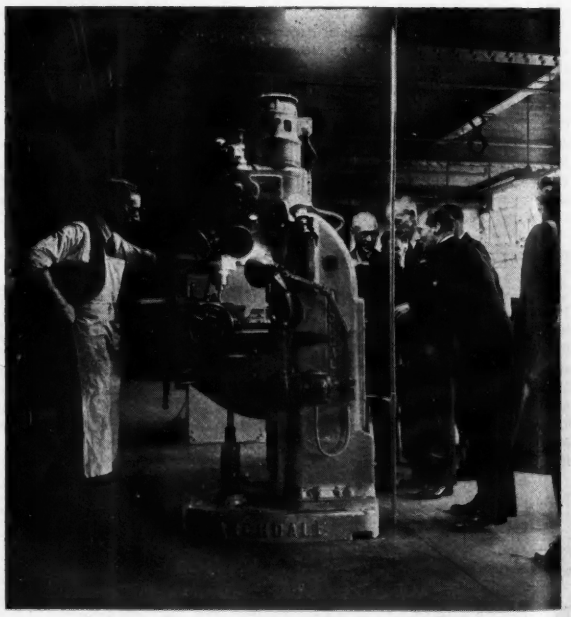
Material is delivered in sets from the stores in movable stillages, and rejected parts are returned to the stores to obviate any accumulation of material at the end of a shift. Wrapping for road transport is done on the conveyor, but cookers for export are packed in a separate room.

Leaving the conveyor lines we passed through the tool room, machine and press shops and visited the combustion air heater department. Here we were shown an air heater which, although primarily designed for the de-icing and cabin heating of aircraft, could equally well be used for factory heating. The heaters are made of Firth's Stainless Immaculate 5, and range from 50,000 to 400,000 B.Th.U. per hour capacity.

Finally our tour took us to the Central Research Laboratories, which were transferred from London in June, 1939, when centralization in Birmingham was decided upon. The general laboratory, research kitchen, chemical laboratory, calorimeter room, radiometer room, metallurgical and physics laboratory all helped to give us an idea of the careful research necessary in the production of efficient and trouble-free appliances.

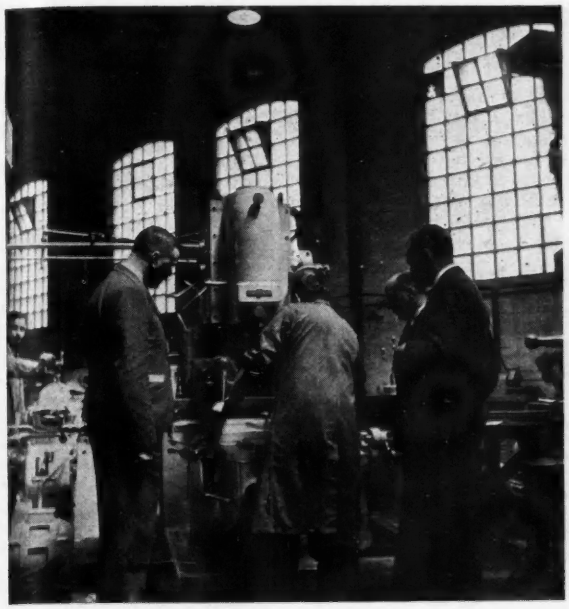
The top floor of the main office building is occupied by the Central Research Laboratories of Radiation Ltd., which includes the Radiation Central Drawing Office. The Solid Fuel Laboratory and the Development Department are situated in another part of the Works, but plans have been completed for adding another storey to the building adjacent designed to house these two and to expand the present accommodation which is becoming very cramped. The war interrupted any immediate expansion, but this plan will be put into effect as soon as the building situation allows. The present floor area of 12,000 sq.ft. will be more than doubled.

The General Laboratory is concerned with all aspects of cooker research, but in addition facilities are available for conducting water heater tests. Methods of technical examination of gas cookers were described—efficiency tests of boiling burners, oven tests in accordance with B.S. 1115, and the practical assessment of cooking performance by cooking meals for a family of four for a week. These were illustrated by reference to the New World No. 1430 gas cooker.



J. Ivan Yates and party study one of the electric drilling pattern making machines.

Burner research, and especially work on the process of injection and on combustion diagrams in relation to burner design, were shown in the form of working apparatus with charts and diagrams of results. This work covers design of burners for all



W. Verity, D. G. Winslow, and H. V. Pye inspect one of the high precision tool machines.

One of the parties in the tool room.

types of combustible gases, from town gas to liquefied petroleum gases, the latter being encountered in the export market. Work on a liquid-filled thermostat was presented and performance tests results and the effect of increasing body temperature were explained.

The Water Heater Section demonstrated the C.28 Circulator connected as for laboratory performance test with a separate exhibit showing the "cycling" performance of the SR 1 snap-action thermostat. Of particular interest was the illustration of how the R.2 Regulo may be accommodated horizontally in the minimum of space to solve an ever-recurrent problem in installation.

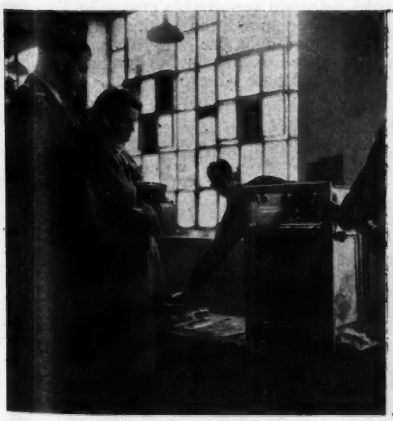
The Research Kitchen is conveniently adjacent to the General Laboratory with a service hatch between. It is used for preparing test recipes and conducting cooking investigations. This is only a temporary arrangement, for in the new extension, plans have been made for a Research Kitchen with Demonstration Room for the training of demonstrators and for conducting refresher courses. Cooking tests in the New World No. 1430 cooker were shown.

The Chemical Laboratory is used for the occasional special analyses that are required in all aspects and subjects of research. Routine chemical analyses for works control purposes are carried out in the Works Technical Department Laboratory. Scale Reducers were on show with a demonstration of the analytical determination of concentrations of the active reagent in the water.

Also on show was the Radiation T.A.R. burner demonstrating the calyx flame, the appearance of which as an intense violet fringe indicated instantaneously the attainment of theoretical total air requirements in the flame.

In the Calorimeter Room, besides the standard Boys calorimeter sets (one of which can be adapted for use on liquefied petroleum gases), are the analytical balance and gas analysis apparatus, both for complete gas analyses and for determinations of small quantities of carbon monoxide. The Bone and Wheeler, G.L.C. constant volume, Haldane Mine Air, Haldane Air, and Orsat forms are used in different determinations.

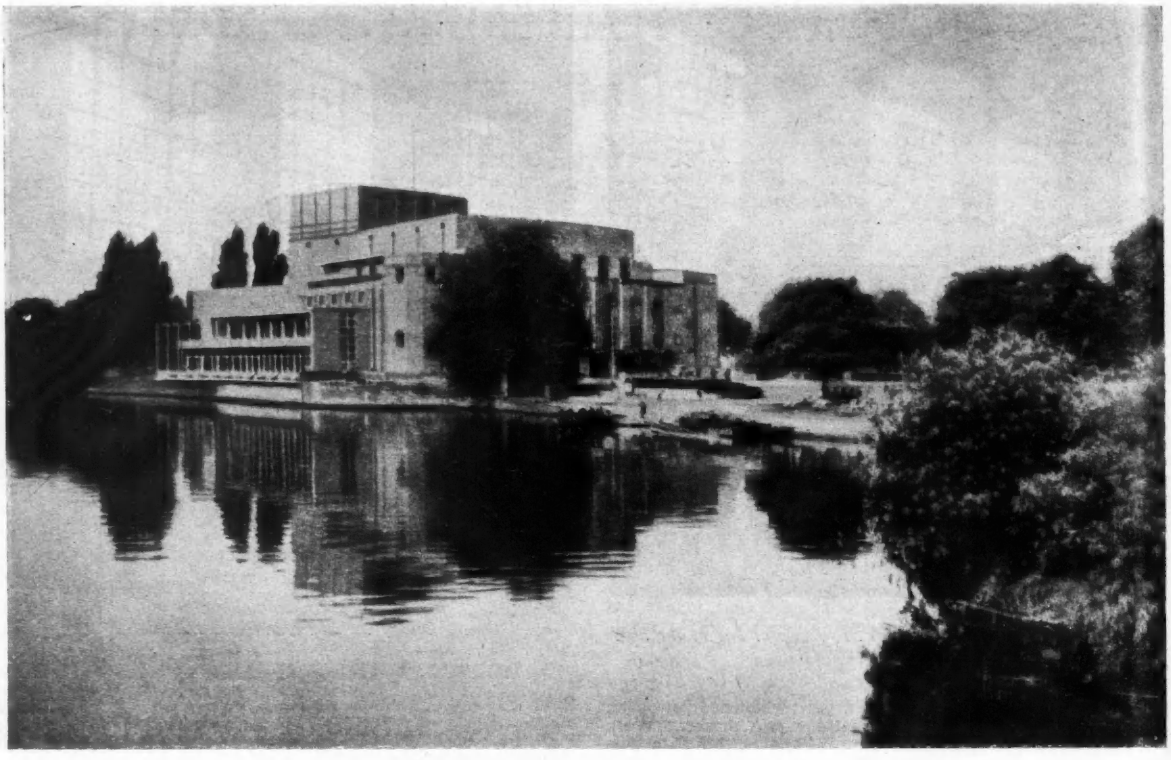
We then made our way to the Conference room where a very pleasant tea was provided and a vote of thanks to the Directors and representatives of Radiation Ltd., was proposed by Mr. E. Crowther, of Newcastle. Replies were made by Mr. J. F. Davies, the Chairman of the Company, Mr. J. Ivan Yates, and Dr. Harold Hartley.



Wistful view of a new cooker being assembled on No. 2 conveyor.

Colonel W. M. Carr, Dr. Hartley J. F. Davies (Chairman of Radiation) and E. Crowther talk to Dr. Braunholtz and the President at tea.

Mrs. Hyde, Mrs. Facer, and Mrs. Hicken view tests in the research kitchen.



River view of the Shakespeare Memorial Theatre

Stratford-upon-Avon

(*Continued from page 657*)

afternoon's sightseeing. He congratulated the Institution on bringing its members for their first visit to Stratford.

Greeting by Sir Barry Jackson

Then a hearty welcome was expressed by Sir Barry Jackson, Director of the Memorial Theatre, who remarked upon the fact that special arrangements had been made in the Conference Hall to lay on gas supplies to facilitate the catering arrangements for the Institution. It is of interest that Sir Barry Jackson is also the Director of the Birmingham Repertory Theatre visited by the Institution on the previous evening.

During the afternoon the members explored the town and visited Shakespeare's birthplace, New Place where Shakespeare made his last home, the Grammar School, and the fine group of ancient Almshouses that must have been well known to the poet. Another motor coach trip was made, this time to the ancient timbered farmhouse known as Anne Hathaway's cottage at Shottery, the home of Shakespeare's wife, where could be seen innumerable Elizabethan relics of antiquarian interest, and also a most beautifully planned and tended flower garden.

Shakespeare in the Theatre

In the evening, a Theatre Dinner was held, again in the Memorial Theatre's Conference Room, and as the highlight of the expedition, a performance of Shakespeare's Romeo and Juliet was attended in the Memorial Theatre. This was the most remarkable of the present Season's plays, directed by the youthful Peter Brook, and it was an excellent opportunity for members of the Institution to see for themselves a play which is being so widely discussed. The vital simplicity of the production was commented upon, and the success of producer and designer combining to create a vivid atmosphere of feud-troubled Verona and the impact of this upon the tragic lovers.

The Design of the Memorial

The theatre built upon the banks of the Avon, to replace the one destroyed by fire in 1926, aroused much comment upon the unusual simplicity of its design, which has always caused great controversy. There is little in its appearance reminiscent of accustomed theatre architecture, but it is usually considered of compelling interest. Functionally excellent, it was designed by Miss Elizabeth Scott, A.R.I.B.A., a grand-daughter of Sir Gilbert Scott, and her design was unanimously selected from among a large number of competitive drawings as the winning entry, by a committee of distinguished architects in an open competition.

The interior contains the most up-to-date stage equipment which makes it possible for the most elaborate production to be staged. Not less important was the comfort of the audience which has been specially studied as regards seating, visibility, and acoustics. And there is no denying that the view from the river side, of the theatre reflecting itself in the Avon, is very fine indeed, as, on a warmer summer evening, must be the terraces over the river on which the audience can stroll and discuss the play during the intervals.

There could have been no more memorable ending to the many successful excursions so ably organized for Institution Week, and it will not be quickly forgotten by those who participated. The organizers are to be congratulated on the smooth running of all the arrangements for the comfort of those who took part.

Anne Hathaway's Cottage

MR. G. C. PEARSON'S PRESIDENTIAL ADDRESS*

FIRST of all, I should like to say how honoured I am to have been elected President of this very live Institution, and I should also like to express early in this Address my thanks to the City of Birmingham Gas Committee for allowing me to accept this office. The Gas Committee could not have been kinder in its reception of the extra duties which have fallen to me, and has given me *carte blanche* to serve the Institution in every way. The Gas Committee was only too anxious that I should be free to do my utmost in this office, and is very concerned that the members of the Institution shall receive the warmest welcome in Birmingham, and that the visit shall be pleasant and memorable.

Looking back over the past year, while the main concern of the Gas Industry has been the shortage of coal coupled with record demands for gas, it has been a very strenuous and, in many ways, an exhilarating time. I think it can be said that the Gas Industry has responded nobly to undreamed-of increases in outputs of gas, whilst hampered by shortages of labour and materials, delays in deliveries, coupled with exceptionally severe winter weather. Although in some districts during the war outputs of gas had fallen very much below pre-war, the past twelve months have seen a revival of outputs to limits far exceeding pre-war figures almost throughout the Industry.

Gas and the Industrial Crisis

The abnormal weather of the past winter created an industrial crisis which the Gas Industry weathered with great credit and was enabled to enhance its reputation for reliable service to all its consumers. In Birmingham, the weather in January, February, and March has gone down in history as the worst since records have been kept, and the gas output reached the phenomenal figure of 575 million cu.ft. in a single week, or 52 million cu.ft. greater than the previous weekly record. There is little doubt that the reasons for these increases are activities in trade and the limited quantities of coal and coke available for industrial and domestic purposes, coupled with higher earnings of the workers. In spite of the present, and we hope temporary, restrictions placed on the use of gas we must expect increases to persist.

All this is really in the best interests of the country, as it is much better for coal to be processed at gas-works than to be burned raw in homes and factories. The Gas Industry should be prepared for an appreciation of this economy and a continuance of the present upward trend of outputs, and should lay itself out to process a larger proportion of the nation's coal. To do this we must make good as speedily as possible any present shortages of plant, and plan boldly for the future; in the meantime we do not ask that industry generally should suffer, on our account, the inconvenience of staggered hours, nor face restrictions of supply for years to come. I am convinced the Gas Industry will continue to meet its commitments during the course of any necessary extension to gas-works plant which may be called for.

The Coal Situation and the Gas Industry's Reactions

It is now clear that the country embarked on last winter with insufficient coal in stock, and this danger must not be allowed to recur. It has at last been brought home that the provision of adequate coal is the first priority in attaining national prosperity. Hand-to-mouth supplies of coal bring about industrial nervousness with the spectre of stoppage or restrictions of production always looming ahead. We must build up our reserve of coal in stock before next winter to restore the confidence so essential for progress and future planning. The Government target of summer coal production appears inadequate and can only meet the situation with very severe restrictions in coal usage through the summer months.

I should like to acknowledge the assistance given to gas undertakings by the Ministry of Fuel and Power during the crisis, in giving high priority to our coal supplies, and congratulate them on their handling of the very difficult situation. Recognition should be made of the splendid achievements of railway workers and crews of ships in getting coal through under appalling conditions. Thanks are also due to the Gas Industry's own employees for their most creditable endeavour in those critical times.

*I.G.E. Communication No. 311

During the coal shortage of last winter the Gas Industry demonstrated its flexibility and adaptability to abnormal conditions. It was necessary to obtain the fullest conservation of coal, irrespective of the implications on the costs of gas production. Everything possible, orthodox and unorthodox, was done to economize coal and still produce the gas demanded. Benzole extraction was curtailed or completely abandoned, resulting in coal savings up to 15%. Water gas production was stepped up to the very limit of capacity, with unfortunate repercussions on the supply of coke to homes and industry. These coal economies by the Gas Industry may not be desirable as long-term policy, but they are the best way of meeting the present situation. A number of improvizations have also been introduced to save coal and to augment production where shortage of plant has been an added difficulty. I refer to various methods of gasifying oil. These expedients are in some cases essential as short-term policy to maintain supplies, but I feel that they should be discontinued as soon as possible in view of the wide variations in gas characteristics which must result. We are jealous of our reputation for uniformity of supply, which may be jeopardized if these practices become permanent.

Coal Handling

Of recent years, gas engineers have been called upon to amend and augment their methods of handling coal to and from store. Gas-works have been existing to some extent on coal stocks built up pre-war, and it is only by gradual reduction of this coal in stock, from year to year, that it has been possible to keep going at full pressure. On the other hand, the tonnage of coal handled to and from stock has been much heavier than in the years before the war, and the additional charge of handling coal has to be added to the ever increasing cost of coal.

It has been necessary to improve coal-handling facilities in order that coal may be recovered sufficiently quickly from stock in quantities to maintain gas production. Coal is now removed from a much larger area of the stocking ground than was the case in past years, and it has not been possible to construct the usual neat coal walls around completed stacks. The usual pre-war limited handling of coal to and from stock often did not justify the provision of expensive mechanical plant, and extra labour was called in when special occasion arose.

With the increased handling of coal to and from stock during and since the war, and with the strict limitations of labour available, more mechanical aid has become necessary. In Birmingham, we have found mobile cranes and diggers of immense help in this task. This type of machinery is made in various capacities and can be a great labour saver in all sizes of works. The most efficient attachment to these machines, for all-round usage, is the long jib with a suitable grab. These machines, used with portable belt-conveyors, will operate over a large area quickly and economically. I should like to make it clear, however, that, while I advocate this type of machine for many existing works and coal sites, in designing a new works a suitable crane should be arranged commanding the whole area of the coal stack.

Retort Repairs

Great difficulty has been experienced of late years in carrying out repairs to retorts, and works can be considered fortunate which are up to date in this respect. Every effort must be made to maintain retort repairs, because if this programme falls behind, the chances of recovering the position become increasingly difficult in following years. It is necessary to plan a forward programme for several years ahead, and to see that it is adhered to. At the present time the delivery of refractories is at least 18 months from date of order, and this means that requirements must be estimated far head of the anticipated date of repairs. Such material should be delivered before constructional work commences, as by this provision not only is the Works assured of the continuity of repair work. but can also be satisfied that the refractories are up to specification, leaving time for replacement should this not be the case. In Birmingham we made stupendous and, I think, successful efforts to maintain our retort-repair programme during the war. Very few experienced retort setters were available, but we made arrangements through the Master Builders'

Association to employ bricklayers without refractory-work experience and to train them. The repairs took longer and cost more, but events have proved the wisdom of this policy.

The Heating of Retort Settings

Mechanical Producers.

Producer gas is the universal medium for heating gas-works retort settings. From the old horizontal fire-bar producer, in which the fire was "dropped" at intervals, was developed the step-grate producer which now usually includes forced primary air feed with steam admission; and the more modern installations are equipped with automatic regulators to maintain steam-air ratio and constant pressure of producer gas. With all these developments, however, the arduous manual labour of intermittent fire-cleaning remains the hardest and most unpleasant job on the retort house schedule, and the quality of producer gas varies during the period from one fire-cleaning to the next.

Mechanical producers have long since been advocated to provide the heating gas for retort settings, but have not been introduced in this country until quite recently on account of high initial expense and a certain loss of sensible heat. Producers of this type can, however, now be arranged to supply hot gas to the settings, and the many advantages to be obtained well justify the additional outlay. I have no hesitation in saying that new installations of carbonizing plant of, say, 2 million cu.ft. per day and over should always include mechanical producers. The advantages are:

(1) Elimination of the unpleasant and arduous manual work of fire-cleaning. This work is difficult to supervise adequately, and unless carried out by the most reliable and conscientious men is apt to be scamped.

(2) The maintenance of a constant quantity and quality of hot producer gas to the settings, resulting in uniform retort temperatures and improved carbonizing efficiency, and in its train possibly increased throughputs per unit major axis.

(3) A saving of the combustible material which is unavoidably removed with ash and clinker in the operation of hand cleaning of fires.

(4) A longer life of retort-setting refractories due to avoidance of temperature fluctuations.

(5) Reduction in dust carried forward to flues, less trouble with sticking dampers, and a reduction of the hot and dirty work of flue-cleaning.

(6) Closer control of the initial heating up of settings, and probably a saving in time and fuel.

Against these advantages I think it will be found that mechanical producers will be more fastidious in the standard of fuel required than step-grate producers. Screened and graded fuel will be necessary, but it is probable that the smallest sizes, always free from dust, will be quite satisfactory. Let us not have any false hopes that mechanical producers will gasify coke dust, at any rate in the present stage of development. The real advantages, however, are very substantial.

Works Efficiency

Simple service carried out by the Gas Engineering Advisory Boards during the war showed that improvements could be made in the efficiency of many undertakings. Coal is an expensive and precious mineral; carbonization is the right way to use it, but carbonizing must be carried out at maximum efficiency. Standards which were considered adequate in some works in the past will not be tolerated for the future. There is no doubt that in some cases insufficient technical data are available, and a works cannot be expected to prosper without means of measuring and assessing raw materials and products.

Some small works in the Midlands have received help and profit from the Chemical Facilities Scheme, as this has enabled such undertakings to assess the quality of their products, and to check up on waste and inefficiency. It should be the aim of every undertaking of reasonable size to prepare an overall thermal balance sheet with knowledge of such matters as coal and coke analysis and characteristics, water in tar, fuel used on works, and unaccounted-for gas. All undertakings should correct gas volume to standard temperature and pressure in order that their statistics may be comparable: it is easy for an undertaking to deceive itself on these grounds alone.

The Use of Steam on Gas-Works

Steam is used very inefficiently on gas-works generally, and there is no doubt that considerable economies can be attained by more attention to this important branch of gas engineering. This applies to practically all existing gas-works, and it is unfortunate that it is so difficult completely to modernize steam methods except when installing new plant. It is by no means uncommon to find gas-works employing steam pressures well below 100 lb., and there are very few works employing steam pressures as high as 150 lb. Low-pressure steam is distributed about the works for power often without superheat to aid transmission, and is frequently used non-condensing. Under such circumstances, only 2% or 3% of the heat supplied to the boilers is available for useful work.

Steam Generation

While it is now almost universal practice to generate steam on gas-works from waste heat, there are few works which do not need solid-fuel-fired boilers to augment or understudy the waste-heat boilers. In most cases these boilers are fired with coke which otherwise could command a high price. Where it is essential to use solid-fuel-fired boilers, coke dust passing through a ¾ in. mesh can be used efficiently. This material realizes a much lower market price than coke of larger size, and until recently was considered very difficult to burn alone on boilers. The main difficulties were inability to keep the fires alight on low loads, and the carrying over of unburnt fuel to the flues. In the case of water-tube boilers with chain grates, the fusing and collapse of furnace arches and fusing of side walls often occurred after quite a short period on normal or high loads, because of the high blast pressures found necessary. I am glad to say that these difficulties have been overcome, and a water-tube boiler with chain-grate stoker has worked successfully in Birmingham for more than 18 months on such coke dust alone. The design of this boiler incorporates a partial water wall or tubes arranged on the inside of the side walls and carried through to external headers communicating with the water drums. The boiler arch is eliminated entirely, and a high blast pressure is permissible without damage to the side walls. The evaporation of the boiler is appreciably increased, and flexibility of output down to 50% load can readily be obtained while the full nominal capacity of the boiler can be realized.

The Generation and Use of Electricity on Gas-Works

Most gas-works processes, apart from power, are either consumers of heat or require steam for chemical reaction, and for these purposes steam is equally satisfactory at a low pressure and after considerable work has been extracted from it. I have been particularly interested in this as we are laying out a new works at Swan Village in our statutory area. We have decided to take the whole of the steam produced from the waste-heat boilers, without exception, direct to electricity generating sets and to use electric power exclusively on the works. This scheme has the advantage that all steam will be used in economical large turbines for power generation instead of being dissipated in inefficient, scattered, small power units. At our other stations, steam is used to generate electricity and for many other power usages and processes on the works, but to provide sufficient power for all of these purposes we find it necessary to augment the steam supply with fuel-fired boilers.

We find that should the steam be raised in the waste-heat boilers on the new works at 350 lb. per sq.in. and then passed in its entirety to an electric generator turbine exhausting at 25 lb., there should be more electric power and process steam available than could be used on the works. The use of augmenting fuel-fired boilers should be obviated completely. The waste gases from the settings will pass through boilers raising steam at 350 lb. at 650° F., and at the outlet of the boilers will be arranged steaming economizers reducing the temperature of the outlet gases to about 200° C. This is a rather lower temperature than is usually attained with steam generated in waste-heat boilers operating at 100 to 150 lb. per sq.in. All steam will be taken to an electric turbine generator exhausting at 25 lb., the latter still retaining 50° F. superheat.

This low-pressure steam will be taken for use in the retorts, producers, benzole plant, water-softening plant, liquor-concentration plant, heating of buildings, hot water requirements, &c.; and in the case of Swan Village new works there will remain a surplus for use on the existing old works.

I find that the electric power generated will be sufficient not only for the power required on the new works, but that there will be a considerable surplus available for the existing works, and that this will result in a considerable economy. This system of working is not even experimental. It is a case of applying well known steam methods to gas-works.

There is still some prejudice concerning electrical drives on gas-works, but I consider this method of power application to be equally as reliable as steam, and more efficient, as it eliminates the substantial losses of transmission and condensation, while the power is produced in a large fully-efficient unit. In Birmingham our generating sets are synchronized with the electric grid in such a way that while the grid is a standby immediately available, surplus current produced can be delivered into the grid at any time. There are outgoing and incoming meters, and we receive payment for current exported, which is set against the cost of any current imported. It will be seen that with this system, and generators in duplicate, breakdown is extremely unlikely. I am very gratified that our electrical engineer in Birmingham is to give a Paper, shortly to be presented before this meeting, on the use of electricity in gas-works, and he will elaborate on this subject.

On the old Swan Village Works we then propose to superheat the waste-heat steam, generated at 135 lb. per sq.in. to a final temperature of 560° F. New water-gas machines are to be installed on the old works, and these will generate steam at the same pressure and super-heat. This steam will then all be taken to a turbine generator exhausting either through an automatically controlled pass-out at 25 lb. pressure, still superheated for process work, or to a condenser. The quantity of steam exhausting to the condenser will vary according to works process requirements, but at all times there will be a substantial surplus over works requirements to pass to the condenser.

As an alternative to exhausting excess steam to a condenser with the loss of latent heat, there is the possibility of using it for water heating as a contribution to a local district-heating scheme.

The electric generator will be synchronized with the one on the new works and also the grid, and such a scheme will result in the elimination of fuel-fired steam on both works and provide a substantial quantity of electricity for sale to the grid.

All the scattered and more or less inefficient steam drives will be substituted by electric motor drives.

Technical Education and Training

During the war years, the Midland Region Engineering Advisory Board made a rough evaluation of the technical staff in the Region and it was considered there was only about half the junior technical staff available to ensure the supervision and the critical control necessary for efficient production on gas-works.

Our raw materials are progressively more costly and our by-products more valuable, so that the monetary value of increased efficiency becomes ever more attractive. Such advantages can only be grasped by reinforcement of technical control.

There is a shortage of young technical men in the Gas Industry and we must expect this shortage to continue for some years. How are we to make good this shortage? Only a small proportion of men from the Universities will come our way, so we must arrange to recruit and train our own junior staff, and we must insist on the attainment of specified qualifications before permanent appointment to the technical staff. The intensive courses in gas engineering arranged by the Ministry of Labour and National Service in conjunction with the Institution of Gas Engineers for returned ex-Servicemen are giving excellent results and it may be wise to consider the continuation of this scheme after the demands of ex-Servicemen have been met. In Birmingham a number of such men have already been specially chosen to take these courses. After successful completion of the six months intensive course leading to the Ordinary Certificate a young man will spend six months on the works, with the fullest opportunities to gain practical experience, and then join the intensive course for the Higher Grade Certificate. With this qualification he will receive a temporary appointment on the engineering staff and will be expected to obtain his diploma in reasonable time. Subject also to proving practical aptitude for the work he will receive a permanent post on full qualification.

In addition, it is intended to appoint a limited number of University graduates, but they, too, will have to prove practical aptitude before permanent appointment.

I should like to draw attention to quite another aspect of education—the scheme for Training Within Industry for Supervisors, or T.W.I., as it is called, of the Ministry of Labour and National Service. The City of Birmingham Gas Department has taken advantage of this scheme, and so far more than 100 "supervisors," ranging from engineers to charge hands, have been through the course of "Job Instruction."

The scheme aims at developing the skill of any supervisor, and the term "supervisor" is used to represent anyone who has the responsibility of directing the work of others. Knowledge of work and responsibilities are basic needs with which the scheme makes no attempt to deal, but however expert in his craft a supervisor may be, and however well informed of his responsibilities, he requires certain skills superimposed on these which represent the real essence of good supervision. These additional needs are the skill of instructing, the skill of handling workers, and the skill of improving methods. Training Within Industry for Supervisors is designed to impart these three skills.

The City of Birmingham Gas Department has appointed from its own staff two trainers who have been through the appropriate courses arranged by the Ministry. All grades of supervisors have appreciated at the conclusion of a week's course the benefits to be gained by applying systematic methods of instruction. I believe this training will result in greater efficiency and all-round co-operation, and I commend the scheme with confidence to the attention of gas undertakings.

I have much enjoyed my contacts with the District Associations and am much impressed with the keenness they show for the welfare of the Industry. They take their meetings very seriously, and the standard of technical Papers and discussion is very high. This particularly applies to the Junior Associations, and there is no doubt that membership of the Junior Associations has become a valuable initiation and training for advancement in the Industry.

The electricity supply industry is about to be nationalized, and among the arrangements to be made for control is the setting up of Area Consultative Councils. These Councils are to consist of 20 or 30 persons, not less than half of whom are to be representative of consumers of electricity and other persons or organizations interested in the development of electricity in these areas.

I think it is clear that we should at once apply to be represented on these Councils, as the Gas Industry is not only a large consumer of electricity, but is likely to co-operate more in the future with the electricity supply industry in the public service. I think that it is recognized more and more that we each have our spheres of usefulness (electricity for lighting and power; gas for heat), and if this is appreciated and we each develop our own sphere of usefulness, considerable advantage to the public, with economy of fuel, will undoubtedly accrue.

Nationalization of the Gas Industry still remains in the air, and in my opinion it is the duty of the gas engineer to look for the advantages which may be obtained for the Industry out of any changes which may take place. Schemes of development should not be held up pending decisions of policy, and projected extensions should not be retarded. We have the Minister's word that such work undertaken now will receive adequate assessment if the Gas Industry is eventually taken over.

Murdoch Lodge

Members of the Evening Star Lodge (London) and the Northern Star Lodge (Manchester) and other Masonic members of the Institution were the guests of the Murdoch Lodge on the eve of the Institution meeting. The W.M., Mr. F. C. Wilson, welcomed Mr. G. C. Pearson, President of the Institution, the Deputy Provincial Grand Master of Warwickshire, Mr. C. F. Monk, and a large number of gas engineers holding high rank in Freemasonry. Mr. R. Scott, who was W.M. in 1922, initiated his son, Mr. D. Scott. Sir Frederick West, responding to the toast of the Grand Officers, described the meeting as a most appropriate send-off for a memorable Institution meeting. The toast of the visitors was proposed by Mr. R. J. Rogers, who referred particularly to the President of the Institution, and Councillor Seymour Brown, Chairman of the Birmingham Gas Committee. Response to the toast was made by the President; Mr. R. J. Risby (W.M. of Evening Star Lodge); Mr. R. Marsden (W.M. of Northern Star Lodge); and Mr. S. H. Lawrence (Ellesmere Port) on behalf of several brethren from overseas.

A Proved Case for Integration

THE President's Luncheon was held at the Botanical Gardens, Edgbaston, on June 3, the principal guests being the Lord Mayor of Birmingham (Alderman A. F. Bradbeer, J.P.), and the Right Hon. Lord Dukeston, Chairman of the National Joint Industrial Council for the Gas Industry. The Loyal Toast was honoured on the proposition of the President.

The **President** proposed the toast of " The Guests." He remarked that the Institution had not met in Birmingham before. There was, however, a parallel to it in 1881 when the British Gas Managers met in Birmingham under the Presidency of Mr. Charles Hunt, who was then the Manager of the Windsor Street Works; and the British Gas Managers eventually became the Institution of Gas Engineers. Mr. Pearson mentioned especially Alderman Bradbeer, the Lord Mayor of Birmingham, and said how very much he had helped with this Institution meeting. The President also gave a special welcome to Lord Dukeston, Chairman of the National Joint Industrial Council for the Gas Industry, and for many years General Secretary of the National Union of Municipal and General Workers. " I think," said Mr. Pearson, " there is no doubt that it is largely due to his common-sense attitude and fair dealing that such good feeling exists between the workers and the employers in the Gas Industry to-day. We also have with us to-day representatives from the Ministry of Fuel and Power and other Government Departments, and I would like to mention Councillor Seymour Brown, the Chairman of the City of Birmingham Gas Committee, and other members of the Committee. I must acknowledge the great help the Committee has been to me in taking the office of President of the Institution this year.

Misgivings Dispelled

" Some people," continued the President, " talk of the Gas Industry as being decadent, but our experiences during the war have dispelled all that. We have proved ourselves to be an Industry capable of supplying an urgent need, and there is none better able than the Gas Industry to meet the call for fuel economy. The more coal carbonized in gas-works and the less coal burned in factories and elsewhere, the better it will be for the national welfare and for real economy in fuel. The electricity people have also economized in fuel, though not so much as the Gas Industry has done, and I feel that it would be a very good thing if there were a fuel policy arranged so that all forms of fuel should be used in the directions for which they are best suited—gas for heating and cooking, and electricity for power and lighting and for certain forms of heating. We are not in any way averse to using electricity in the City of Birmingham Gas Department; indeed, the Gas Department is among the largest users of electricity in this City."

Alderman **A. F. Bradbeer** (Lord Mayor of Birmingham), responding, said that in Birmingham they regarded their gas undertaking as very far from representing a dying industry. " We have an undertaking which is the second largest in Great Britain, second only, I think, to the Gas Light and Coke Company, and the largest municipal undertaking in the country. Last year we produced 22,000 million cu.ft. of gas, an increase of 11% over the previous year. Although for over 20 years I have served on the Electricity Supply Committee, whose activities are just as vital to the industrial and domestic life of this City as is the Gas Industry, I must say that if the electricity undertakings of this country had been able to show an overall increase of 11% all over the country we should have avoided a great many of the troubles we have lately found ourselves in. Our gas undertaking in the last year used 1¼ million tons of coal and seven million gall. of oil, and a total revenue of £5,250,000 was obtained from 375,000 consumers.

Triumph of Regionalization

" The area of the City of Birmingham is about 80 square miles, but the area served by the gas undertaking is approximately 200 square miles, so that in fact already in Birmingham we have constituted in my judgment a regional undertaking which would rank as one of the largest in the country serving this highly developed, industrialized, and populated area.

" In Birmingham we are not looking forward with much joy to handing our undertaking over to some regional authority. We consider we have built up an enormous undertaking. If anyone can tell us where we have made mistakes, or how our work could be done better, we should be glad of their advice, but while we are entirely in agreement in the national interest and as citizens of the country that the Gas Industry should come under national control, we are not so sure that it is going to come under public control. It is true that in the electricity supply industry there will be Regional Boards, but the average Britisher is not too fond of regional boards where he has no opportunity of having a voice as to who shall be appointed to such regional boards. If and when the Gas Industry is taken over by the Ministry of Fuel and Power we in Birmingham certainly hope that sufficient attention will be given to the desirability from every point of view of ensuring that the governing body is kept in the closest possible touch with the consumers and the producers in the Industry."

The Right Hon. **Lord Dukeston** proposed the toast of " The Institution of Gas Engineers." " It is," he said, " a very great Institution. The future of the Gas Industry depends, I will not say entirely, but in large part, on the engineers who have pioneered this great Industry and brought it to the stage of efficiency which it has reached to-day. Perhaps I had better say a few words regarding the relationship of the engineers with the side of the Industry in which I have been most concerned. I do not know how many years I have been in one way or another attached to the Gas Industry, but it is a considerable number. I knew my own organization when it was the Gas Workers' Union, and I think I am No. 9 on my old branch, and that is going back more than 40 years. During those years in association with both sides of this great Industry I think I can claim that the relationships have at least been equal to the best that can be found in any industry in the country. In the early beginnings we had our troubles.

Cordial Relationship

There were strikes here and there and so on, but I think if we look at the history of this great Industry from the end of the first World War we have created a record of joint relationships unsurpassed in the history of joint relationships. There has never been a major dispute and those of us, some of whom are in this room, who have served on that joint body pride ourselves on the fact that we have never had to seek outside aid to help us to arrive at a settlement, no matter how difficult the negotiations may have been. That is a record of which we are all very proud, and I can say that when it fell to my lot to succeed as Chairman of the National Joint Industrial Council the late Sir David Milne-Watson I regarded that decision of the Joint Council, particularly as the proposition came from the Employers' side, as being the highest honour that had ever been bestowed on me in a fairly long industrial experience.

" We really have had no major labour problems and that in part, I think in very large part, is due to the kind of contact built up between the undertakings and the trade unions' representatives, who do not wait until difficulties become almost insoluble. Owing to the ready access our people have had they have invariably settled their problems on a local level, and the national Joint Council was troubled very little indeed with these matters of local dispute. I confess there are some times when I have a feeling that we are drawing the net a little too tight. I like to see as much settled on a local level as possible provided it does not upset or violate overall national decisions about which we have to come to agreement. I am all in favour of local autonomy where local autonomy is practicable, and providing it is done in the right spirit there is no reason at all why these local or regional matters should always be referred to the centre. On big national issues, of course, we must lay down general policy, but its interpretation need not be as rigid as sometimes there is a disposition to make it.

Complementary Industries

" We are reluctant to make any comparisons between the Gas Industry and our friends on the electrical side. I have always believed that instead of being competitive we should be complementary to each other, and I rather deplore the waste which inevitably arises when an artificial form of competition is imposed in industries which, as I have already said, ought really to be complementary to each other. I am rather disappointed that the Government have not pushed ahead with their schemes for dealing with the Industry. I know that view may not be acceptable to everybody, but I think my time would have been of little value if I had assessed your opinions and merely repeated them. I think the time is here when we should have complete integration of fuel and power from one end to the other. That we are an efficient industry in no way invalidates that view. If we were now in the process of creating policy there might be a great deal of ground over which we could debate. But the policy has been decided, and my complaint is that the time lag between the determination of that policy and its implemenation is not good for the Industry and it is not good for the country."

Dr. **Harold Hartley** (President-Elect): In responding on behalf of the Institution of Gas Engineers I must say that Lord Dukeston has, in proposing this toast, covered a wide range. First I would like to say that the function of this Institution is to unite technicians of all kinds—engineers, chemists, and physicists—who serve the Gas Industry, for the advancement of gas science, and for the better education of those who may be the engineers of the future, and above all to ensure that there shall be a hall-mark of competence. By undertaking that work the Institution has in fact made itself responsible for the technical development of a very old Industry. It is its duty to see that as new knowledge is acquired it is applied to the experience of the past. It is an article of faith of the members of this Institution that the best results are obtained from our coal resources by treatment prior to

burning. They believe it to be important that the coal should be carbonized in a scientific manner, and that it is wasteful to burn coal. This Institution is one of the great Institutions founded in the last century. Each of those Institutions has in its own way done a great deal for the betterment of engineering science.

"Associate Membership of this Institution involves not merely a modicum of engineering theory but also a considerable practical experience. The trend of development in the Institution is in the direction of making that Associate Membership equal to an engineering degree in that particular branch, but not, of course, with the wider education involved in a university course. It is, I think, a fact that these engineering Institutions represent a modern form of the old craft fraternities that originated six or seven centuries ago.

Early Guilds

Societies were formed in those days for the protection of various types of craftsmen, and they flourished to the advantage of the industries in those towns in which they operated. They were, however, rather rigid in their outlook and structure and became incompatible with the developments that were taking place. With improvements in manufacture they crippled the freedom of the individual in the face of increasing competition. They concerned themselves with selfish interests and they did not consider the welfare of the community as a whole, and in fact they became an unmitigated nuisance. Their privileges were abolished in the middle of the last century. But those craft societies had, I think, a very big influence on modern political development.

"You will remember that at the beginning of this century there was a strong body of political opinion known as cold Socialism which advocated the application of the democratic principle to industry. Its concept was that the industries should be owned by the community which used them, but that they should be operated by the workers by hand and brain. Whether you think the full application of democratic principles in industry is desirable or not, the progress of evolution has already laid down the path which we shall tread during the years that still remain to us. Political development in the near future will affect all sections of the community represented by this body of workers by brain, and if nationalization is applied it would seem to be a development from the craft guilds. Its application to this Industry will affect directly the members of this Institution who alone, in my view, possess the technical knowledge necessary to ensure that the political change shall be brought about in such a way as to yield the best results to the community as a whole.

The Functions of the Technicians

"Technicians are essentially men of science, men who are concerned with applied science, who, like scientists, are more and more coming to the belief that increase of knowledge is obtained most readily by co-operation and by the publication of work and experience. That spirit has pervaded this Institution for two reasons: first because it has always served a public utility, and secondly because the idea of aiding one another has always prevailed. The work done by our engineers during the war was an outstanding example of that. The growth of education, the increase of knowledge, and the increasing political consciousness of the individual during this last century have done much, I think, to put us in the position visualized by Henley when he said, 'I am the master of my fate; I am the captain of my soul'"

"The career of Lord Dukeston epitomizes that sentiment. I remember 35 years ago we had in Warrington an able, energetic, organizer of industrial workers who held and propagated what were then thought to be very advanced views. He attracted attention by the sincerity and eloquence with which he put forward those views. His personality, his intelligence, and his industry have enabled him to mark out and fulfil a career of which, being human, I am sure he must be very proud."

Councillor **Seymour Brown** (Chairman of the City of Birmingham Gas Committee) expressed to the President their great appreciation of the dignified way in which he had presided over the proceedings.

W. L. S. Spinks

Aspects of Gas Measurement*

By W. L. S. SPINKS
(Controller of Gas Sales)
and A. E. MASON, A.C.I.S.
(Superintendent, Meter Repair Shop)
City of Birmingham Gas Department

A. E. Mason

FROM the point of view of a gas undertaking, the necessity for measuring gas arises from two main reasons: first, the gas engineer must compute the efficiency of his gas-making process and evaluate one type of plane or class of coal against another; and second, he needs to provide a basis for the undertaking's charge to its consumers for gas supplied.

Speaking broadly all gas made is measured twice; once before it enters the gasholders, and again as it enters the consumer's premises. The paramount importance of correct measurement by consumers' meters and by station meters cannot be overestimated.

It is sometimes said that many undertakings do not take sufficient care to ensure that their station meters are really accurate, and the Authors have, therefore, thought that it might be of interest to set out in some detail the methods adopted in Birmingham for testing station meters. On outputs, as shown by station meter registrations, many decisions have to be based and it is well worth while to establish a system of testing which will give a guarantee of accuracy within reasonably fine limits.

The goodwill and satisfaction of the domestic consumer is built upon a faith that he can rely upon his gas undertaking to give him a fair deal, and most important factor in building up this reliance is the assurance that the gas he has used is correctly registered by his meter.

*From Communication No. 313 of the Institution of Gas Engineers

The industrial consumer often has to decide what type of heating he shall adopt on very small margins of cost between one system and another, and faith in the accuracy of meter registration is essential in helping him to come to a decision.

Although unaccounted-for gas is referred to in this Paper, the Authors have not put forward any suggestions for bringing the figures used for "unaccounted" on to a common basis, but have merely placed on record the experience of the City of Birmingham.

Types of Station Meter in Use in Birmingham

All works have developed with the years, and most gas-works plant has a long, useful life, so that a number of different types of station meters are in use up and down the country. Birmingham in the past relied upon the wet drum to measure the gas made, and a very accurate and reliable figure was obtained, as there was positive total displacement. Varying sizes of this instrument, with capacities of from 40,000 to 250,000 cu. ft. per hr., are still in use.

In some cases, however, it was found more suitable to use the inferential rotary meter which satisfactorily measured gas up to 500,000 cu. ft. per hr.

As demand for gas grew, five of the older wet-drum meters were converted to bell type, which trebled their measuring capacity. During recent years the Holmes Connersville meter has

been introduced, resulting in a further great saving of space. At the present time all these types are being used, and comprise:—

Type	Number	Capacity (1,000 cu.ft. per hour)
Wet drum ...	1	10
	1	12
	1	40
	1	80
	1	100
	1	160
	3	250
Rotary	1	40
	2	100
	1	150
	1	200
	1	300
	2	500
Bell	2	450
	2	300
Connersville ...	5	250

These provide a total hourly measuring capacity of nearly 6 mill. cu.ft.

All these types are well known, and in the following notes, therefore, prominence is given only to those points which may lead to errors in registration or which require regular maintenance.

Characteristics (Limitations and Advantages) of Each Type Used

Wet Drum.

This type having been in general use for so many years, it needs little explanation. The measuring chambers are formed by a partitioned drum revolving in water. As the water forms one side of the chamber it is essential that the water be kept at the predetermined level. Steady drip of water in, and then out from an overflow, ensures this, providing that inlet pressure be acting at the point of overflow. A pressure gauge has been fixed immediately at this point on all of Birmingham's meters and is readily seen by the state-taker on his hourly inspection. Failure of pressure at this point leads to a low water-line and consequent error in registration. This type of meter has proved itself to be accurate but cumbersome, judged by present-day standards. If bearings be kept greased, attention be given to pressure pipes and gauges, adequate protection from frost be given, and the instruments be kept in fairly constant use, wet drum meters have a long life.

Repairs are generally confined to the renewing of stuffing at index glands, to leakages around plate joints, to stoppages of pressure pipes, and to drum leaks (generally at the crown end).

Even a small internal defect causes a major job and puts the affected meter out of commission for a considerable time.

Should the opportunity present itself, it is well worth while going through a drum in a meter of 250,000 cu.ft. per hr. capacity, for it is hard to conjure up visions of treading forward on a moving floor and passing from one chamber to another, lighted only by a torch, and hard to realize that the centre drum shaft is well beyond reach. It is an experience one never forgets.

Of possible causes of wrong registration, *slow result* may be due to:—

(*a*) Low water-line in drum proper, caused by stoppage in pressure pipe; failure of water supply to maintain level; binding of drum; or hole in spout below water level.
(*b*) Unsound drum.
(*c*) Broken tooth on countershaft driver wheel.

Complete failure to register may be due to causes as shown at (*a*) above, the water being so low that the drum will not be sealed at the centre; or by defective gearing between drum shaft and countershaft.

Fast result may be due to the water-line being high through stoppage in the overflow; by worn bearings of shaft, lowering drum into the water; or by the wrongful raising of the overflow stand pipe in an attempt to overcome slow result found by test at low capacity.

Rotary Meter

The rotary meter registers velocity, and consequently does not register correctly at small throughput. It is basically an anemometer—*i.e.*, a number of vanes superimposed on a vertical spindle. The spindle is held in suspension by Timken or roller bearings completely immersed in lubricant. This lubricant must be an oil (*e.g.*, Velocite E) which will not emulsify with the mercury in the seal. The bearing and index are sealed from gas by a mercury seal. An agate bearing is used in small sizes. Inlet gas passes through porcelain product tubes which disperse the gas evenly on to the underside of the vanes, causing rotation of the spindle. It is essential that there be a minimum of friction in the bearings and index gearing. Provision is made for draining any condensate from the base by means of a plug or sealed pipe. Recent body construction has been of welded steel sheet.

Its outstanding advantage, apart from the small space it occupies, is that the whole interior can be taken out with very little trouble for inspection and correction, which may be carried out in a matter of hours only. Very little attention and maintenance are needed, and when worked within capacity range the meters have given satisfactorily accurate results. This type of meter should be avoided where gases with tar in suspension may be expected, as anything adhering to the product tubes or fan vanes would affect registration. In particular, naphthalene would soon put this type of meter out of commission.

Sudden increase in pressure will blow out the mercury seal, registered gas then passing through the index.

Of possible causes of wrong registration *slow result* may be due to binding in bearings, which may be so bad as to stop registration completely; or to emulsification of the mercury.

Fast result may be due to slight fall of the anemometer nearer to product tubes; to partial stoppage in product tubes consequent upon broken linings or dirty surfaces; or to condensate building up sufficiently to lessen the aperture to the product tube caused by stoppage in the draining pipe or inattention to draining.

Bell Meter

The bell meter was designed on the principle of a dry meter. The measuring chambers are not bounded by flexible leather, but by oscillating bells rising and falling, the open ends being sealed in liquid. There are four bells, each contained in a separate compartment, balanced in two pairs and carried on a square shaft working on self-aligning bearings. Eight pockets of gas are formed, the pocket under the bell being connected by an open-ended gas passage to the outside of the other bell to which it is fixed. Consequently, any pressure on the one bell is transmitted to the under side of its connected bell, and so gives a balanced, steady motion. Gas is led along a passage through the centre port of one of the two pairs of three-ported arc slide valves. The oscillating cover directs gas to the outside of each bell in turn. While the gas is being led to the outside of one bell, and depressing it, the other bell to which it is attached is rising, the valve cover then being in position to allow gas from above the bell and the under side of the other bell to pass to the outlet. As in a dry meter, the position of the other pair of bells is such that no dead centre occurs. The movement of the valve covers is synchronized with the bells. The movement of the bells is restricted by a variable tangent arm, the centre of which carries the index shaft. Measurement of the meter is altered by adjusting this tangent which has the effect of governing the displacement by the bells. The sealing liquid is usually water carrying about 11 in. of gas oil. This helps to preserve the interior and provides a reservoir for supplying the lubricant which is very necessary where there are so many working points and valve faces. The level is not material within limits, provided it serves its purpose of sealing the bells.

An overflow from the water is provided, similar to that in a wet meter. The oil is picked up by miniature buckets attached to an endless chain driven by the meter, and deposited to a box situated at the top. where it passes through a filter and gravitates through feed pipes to the working parts and the valve faces.

A later, improved method, is a provision for the oil to pass from the meter proper to an external filter tank, the oil then being raised by a pump, operated by the meter, to the small tank situated at the top. Both methods are also used to clear a sump which collects any oil thrown over the gas passages.

Grease nipples also are used for forced lubrication of the bearings. The Authors have found from experience that the bell meter gives satisfactory service and accurate, positive results, provided that the oiling and greasing arrangements be kept in efficient working order. Birmingham's bell meters have been fitted, with tell-tale sight glasses and exterior filter tanks to help in this direction, and periodical attention is strictly maintained.

Oil Decreasing.—Observation should be kept on oil contents, for should oil from the level be carried forward in the gas, water will take its place and a condition will arrive where water is being fed into oiling pipes.

Oil Increasing.—In one instance it has been found necessary to fit a cock at a point in the water, 2½ in. lower than the oil,

to test whether the quantity of oil is increasing through absorption from the gas passing over it, gas oil having an affinity for benzole. Benzole absorption causes loss of lubricating properties, and the oil must eventually be completely changed. It will be appreciated that because of difference in specific gravity, a changeover from water to oil would falsify the level in the meter.

If the oil gauge could be kept clear, observation of this would suffice, but this the Authors have found to be impracticable. When the quantity of oil increases to such an extent that it reaches the top of the gas passage, it flows over, and, aided by siphoning, the meter bells become unsealed and the meter fails to register.

Of possible causes of wrong registration *slow result* may be due to failure in the oil system to keep valves sealed, thereby allowing slip.

Complete failure to register may be caused through sudden inlet pressure throwing an oil seal over spouts, aided by siphoning. Bells then become unsealed.

Connersville Meter

The Connersville meter consists of two cast-iron impellers enclosed in a cast-iron casing. The cross-section of the impellers is in the form of a figure eight; they are maintained in proper relationship by gear-wheels which mesh into each other.

The gear-wheels run in an oil-bath, and the impeller shaft runs on ball bearings, which are being continually lubricated by a drip-feed from glass reservoirs externally situated and regulated.

A revolution of one impeller displaces two measured pockets of gas. The impeller tips are machined and a few thousandths of an inch of clearance is allowed; part of the gas slip is taken care of in the index gearing. The slip prohibits the meter, as such, being stamped by the Board of Trade. The makers claim accuracy unless throughput is less than one-tenth of capacity. A flushing device is provided to wash the impellers if at any time the loss of pressure, as shown on the fitted gauges, is higher than normal; the normal loss of pressure at badged capacity is not more than ten-tenths.

Gas enters the meter through the inlet box, and exerts a pressure on the impellers, causing them to revolve and travel downwards; the gas then passes out of the bottom through the bedplate. Slipping gas is travelling in the same direction as the tip of the impellers and at approximately the same velocity.

Apart from the floor area space the meter needs, the advantages of this type are:—

1. Accuracy is not dependent on water level.
2. Measurements cannot be adjusted by altering the level of a seal.
3. Accuracy is not affected when overloaded.
4. Gas remains as dry as when it enters.
5. Measurement is not affected by variation of specific gravity.
6. Low differential pressure loss.
7. It is guaranteed to ± 1% by the makers.

Comparative measurement cannot be checked at low consumptions because of the slip between the impellers. The Authors' experience has been that it is a perfectly satisfactory meter, provided it is used on clean gas and worked fairly continuously.

B. and M. Meter

Although Birmingham is not at the present time using this Brandl and Marischka meter as a station meter, it has done so in the past, and this Paper would not be complete without including it, as from the Authors' experience, it has proved to be a very satisfactory positive meter, with easy access for repairs and giving little trouble, provided the oil-line is maintained. The Department has a number on the district in use by large industrial consumers.

The meter consists of a cylindrical drum divided into three measuring chambers sealed by gas oil contained in the lower half.

The drum is built around a centre spindle supported on a ball-and-cup bearing, and is guided on an inner and outer circular track in an inclined position. The ball joint is positioned in the inlet standpipe and greased from an external Stauffer's lubricator. The drum rolls; it does not revolve in the manner of an ordinary wet drum. The position of contact on the track does not change apart from the rise and fall. The drum is tested for a "gyratory creep." The position of the drum, rising above the seal at the centre, allows gas to enter the measuring chamber, the rolling motion causes that part of the drum to fall below level, the gas having been guided through the drum to the outer perimeter or exhaust of the chamber, which has risen above the level and allows discharge of the gas to the exterior of the drum and so to the outlet. The top of the drum shaft moves in a concentric motion and is geared to a "direct-reading" index.

It discharges the amount of gas only to the extent of the displacement determined by the rise and fall of the drum; not total displacement.

A sighting gauge is provided to enable the oil to be maintained at the correct level. This is important, as there is a very small seal. This has recently been taken care of by the provision of a small reservoir of oil situated in the base, the oil being continuously fed to the level automatically by the meter, finding its own level at an overflow. This should help in lessening the visits for maintenance and will cancel out any disadvantages it had in this respect.

Note of Warning.—During the war, when Birmingham was extracting benzole, it was found necessary continually to supplement gas oil to maintain the level. However, since this practice has ceased, a complete changeover has taken place and it has operated very rapidly, for the Authors are now becoming embarrassed by a large quantity of oil taken from B. and M. meters. An analysis of this oil shows that it contains from 10 to 20% of benzole, and it is expected to rise to probably 30%. It will be appreciated that in this proportion it has a very low flash-point, and safeguards must consequently be taken.

Repairs

By raising the top of the meter the drum can readily be lifted from the track, for easy access to the bearing, and any repairs needed are usually confined to this; the present construction should prove to be a very reliable meter. The pressure loss is lower than that of a wet-drum meter.

Of possible causes of wrong registration *slow result* may be due to the oil level falling below the seal, causing partial registration only.

Complete failure to register may be caused through a defective index or a broken and a disengaged "dog."

Recordings of Rates of Flow

It is most useful to engineers to be able to see at a glance the rates of flow through station meters. Effects of alterations in the retort house and elsewhere can quickly be seen without waiting for the next hourly state taking.

The Connersville meters at Saltley Gas-Works are fitted with an indicating and recording tachograph which shows on a dial the rate at which gas is passing through the meter in cu.ft. per hr.

Some years ago, for experimental purposes, the Authors fitted to a rotary meter a distant-flow indicator, operated by means of an electrical device.

Testing of Birmingham's Station Meters

In the past Birmingham relied upon the wet drum to measure gas made, and, of course, a very accurate and reliable record was obtained. The greatest difficulty was to know whether accuracy was being maintained, and then to remedy any defect revealed. Varying sizes were in existence, from 40,000 to 250,000 cu.ft. per hr., and the practice for verifying registration was limited to testing against a 100-light test-meter. This was slow and laborious, and was more exacting than was really necessary, for the first essential of the test was to obtain absolute soundness. With a drum probably 14 ft. in diameter, and a case made up of sections with a roof that would move when pressure was exerted upon it, much time was spent attempting to get ready for the test to meet the stringent conditions. A leak of, say, 10 cu.ft. per hr. when passing 600 cu.ft. per hr. would be material, but when passing 250,000 cu.ft. per hr. it was negligible. When a leak was revealed, the drum was wedged in an endeavour to locate the leaky chamber. The time taken in testing was so long that changes in temperature were inevitable.

It was this apparent waste of effort which led Birmingham to take steps to test its meters at a higher rate, and the largest plant which was thought to be reasonably transportable was bought. It has proved to be a very valuable asset to the Department.

From experience the Authors had found that rotary meters were accurate when working at their badged capacity, and for

size and weight were ideally suitable for such a purpose. So this type was chosen—one having a capacity of 50,000 cu.ft. per hr. and which could be read to 1 cu.ft. It was mounted on a bogey to facilitate transport.

A portable-fan plant was bought, with interchangeable A.C. and D.C. motors to enable air to be used for the purpose.

The fan is a 5½/30 in. Climax multi-vane fan with ball bearings. The A.C. motor is of dual frequency, 3½ b.h.p., 440 volts, nearly 5 amps., 25/50 cycles, flameproof type made by The Lancashire Dynamo and Crypto, Ltd.

An Ellison oil-immersed, direct-on starter is used, with no-volt release for 50-cycle supply, isolation switch, and flameproof casing.

The D.C. motor is 220 volts; 15 amps. The starter is a Vlasto Clark Watson drum-tight non-reversing. The fan plant is built upon a transportable bogey.

Test-holder.—A holder of 3,000 cu.ft. capacity, 18 ft. in diameter, and overall height 35 ft., was erected, to use as a basis and to enable the rotary test-meter to be checked frequently. The holder is erected under cover on a site where sun cannot penetrate, in order to avoid wide temperature fluctuations. The water-sealed holder bell carries a marked scale, and the middle 2,000 ft. can be read off on a flying start and finish. The holder was verified by careful mathematical measurement and tested against the 100-light positive test-meter which had been previously verified by the City Justices. Oil on the water preserves the sheeting. The pressure thrown by the holder was found to be 77/10 when full, and 71/10 when nearly empty. The average of 74/10 is used for all tests. Temperatures of the air and the water are taken during the course of any tests. As the area of the water coming into contact with the air is only one-sixth the area of plate coming into contact with the air, allowance is made for this by taking only one-sixth the difference of temperature for water temperature.

The fan plant is connected by a 12 ft. length of armoured flexible rubber piping to the inlet of the holder. The outlet is controlled by a quick acting 6 in. lever cock. Another flexible pipe connects the outlet of the holder to the inlet of the test-meter. The speed is governed by a 6 in. screw-down valve on the rotary test-meter outlet.

Prior to testing any station meter, the rotary test-meter is compared with the holder, and the error found for calibration when testing. Corrections are made for temperature, pressure and barometric pressure to the standards adopted by the Department—*i.e.*, temperature, 60°F.; pressure, 29·70 in. mercury.

To facilitate testing, small 6 in. valves have been saddled to the inlet and outlet bends of all station meters. These 6 in. valves are blanked off when not in use.

Steps Taken when Testing Station Meters

The first step is to isolate the meter from the works mains. Although the valves are tightly closed, in order to ensure perfect soundness, a body of water is put on to the face of the Works valves. This seal must be maintained throughout the test; it has been found necessary to have a continuous trickle of water kept to its level by a sealed overflow pipe; or even a tar seal may be required.

The fan plant is connected to the 6 in. valve on the inlet of the station meter, the rotary test-meter to the outlet; the outlet of the rotary test-meter is continued to the atmosphere. The connexions are made by the 6 in. flexible piping. Care must be taken to level the rotary test-meter.

The blower (fan plant) is started up, and the outlet valve on the rotary test-meter adjusted to pass the same amount as when the rotary test-meter was tested, at approximately 45,000 cu.ft. per hr. Care must be taken at the end of the testing line that no lights are in the vicinity, having in mind that gas is temporarily being driven from the meter proper. After air has passed through and conditions have been allowed to settle, and, in the wet-drum type of meter, the water level has adjusted itself, readings are taken of both meters, and the temperatures and pressures noted frequently. The Authors' practice is to take three 10,000 cu.ft. runs, which take approximately 40 min. The rotary test-meter reading is calibrated, and the figures of both rotary test-meters and station meter are corrected to the Department's standards.

This report sheet is made up and forwarded to the engineer of the Works, his daily "make" is calibrated accordingly, corrected to 3 in. inlet meter pressure, and to the standards mentioned.

At the conclusion of the test it is necessary to purge the air from the meter; the inlet valve is cracked and gas is passed through for about one revolution of the meter. A Short's leakage indicator is used at the point where it is emitted to the atmosphere, care again being taken that no lights are in the vicinity.

The cycle of operation is therefore as follows:—

1. See that inlet and outlet thermometer and inlet pressure gauge are in working order.
2. Shut down inlet and outlet valves to station meter.
3. Flood both these valves to ensure soundness.
4. Connect fan plant to 6 in. saddled inlet valve by means of 6 in. armoured flex.
5. Connect 6 in. saddled outlet valve from station meter on to inlet rotary test-meter by armoured flex.
6. Connect another length of armoured flex from outlet of rotary test-meter to atmosphere.
7. Open 6 in. valve on inlet and outlet of station meter and the 6 in. valve on the outlet of the rotary test-meter.
8. Having stationed a "looker-out" at atmosphere end of testing line, start up motor of fan plant and regulate by adjusting valves on outlet of rotary test-meter until air is passing at approximately 45,000 cu.ft. per hr.
9. Allow water-line in station meter to adjust itself to this speed.
10. Station observer opposite index of station meter and another at rotary test-meter.
11. Observer at station meter gives word when the index finger is vertical, state of rotary test-meter is taken, and air runs through till 10,000 cu.ft. has been registered by station meter when consumption of rotary test-meter is noted.
12. During test take inlet and outlet temperatures and inlet pressure of both meters.
13. Repeat twice.
14. Ascertain barometric reading on works during test.
15. Correct readings to standard.

When testing bell meters it is essential that a commencement be made immediately after the meter has been working to capacity. This ensures that there is sufficient oil seal on the valves.

When testing the Connersville type, the plate covering the unseen revolving index drum should be removed in order to facilitate more accurate reading.

On Saltley Works there is a battery of four 250,000 cu.ft. per hr. meters. By-passes have been provided to allow one meter to be used as a test-meter, and the other three can individually be checked against it at capacity rate.

The rotary meters are so situated that they can be tested against a positive meter, either wet-drum or bell type, and are checked at the rate they are usually worked.

Testing cannot be done satisfactorily unless at least one meter can be shut down for such purpose and still leave adequate capacity for day-to-day makes.

While testing at 50,000 cu.ft. per hr. has served a good purpose, it is felt that, now Connersville meters are being used, progress must be made to test at a higher throughput, and steps are being taken to enable this to be raised to 100,000 cu.ft. per hr. All testing is done with air. This involves an explosive mixture in the meter at the beginning of the test and again when putting the meter back to work. Some day, explosive mixtures in gas apparatus may cease to be permitted: that would mean purging with inert gas.

A practice is made of testing inferential meters twice a year, and positive meters once a year, at regular intervals. All thermometers are passed to the laboratory for verification, each six months, which is prior to the commencement of the tests. Numbered angle thermometers are used.

At the Department's coal-test works, when testing the small wet-drum meters, a 100-light test-meter is used, the index of which can be read accurately to 0·1 cu.ft. The practice is, first to remove the station-meter index and to affix temporarily a long pointer on the drum countershaft. This enables one to mark accurately one revolution of the drum by observing the pointer passing a mark on the case. The gearing can be checked through to ascertain the capacity per revolution.

Gas is led to the test-meter, which must be levelled and carefully water-lined. From the outlet, gas is passed to the inlet

of the station meter. A pipe is run from the outlet of the station meter to atmosphere, the furthermost point being controlled by a cock. This cock is turned off, and the gas valve to the test-meter opened. After the chambers of the drum have filled and settled down, the gas is turned off. If there is any leakage on the fittings or drum, the pointer on the test-meter will move and reveal it. Perfect soundness must be obtained before the test is commenced. The meter is then set working at the test-meter capacity, in this case 600 cu.ft. per hr. The station meter water is allowed to find its level. Inlet and outlet temperatures and inlet pressures are read frequently during the test.

The Authors' practice is to take three revolutions of the drum, each revolution being noted, and this is repeated three times or more if the temperature conditions do not remain reasonably stable. The amount of gas recorded through the test-meter is noted. (The test-meter is checked against an 11 ft. test-bench prover.) Corrections on both meters are made to the Department's standards, and any error is ascertained.

Handslip Method of Testing a 250,000 cu.ft. per hour Connersville Meter

Accurate measurements and machined surfaces are indispensable in the Connersville meter; the volume of the measuring chambers is predetermined and is given to the third decimal place by the makers. A hand wheel can be engaged into the impeller shaft to enable the impellers to be turned at will. If the meter be shut down, the inlet and outlet closed, and the pressure allowed to disperse, the impellers can be revolved, gas slipping past the clearances allowed between the impellers as they pass through the measuring chamber. Consequently the time taken to complete the cycle signifies the volume of gas slipped. The differential pressure is created and the amount of slip at that differential pressure can be computed as a percentage of the speed of the meter working at that same differential pressure. However, as the slip is taking place in the opposite direction as when working normally, a test made by the makers against a prover shows that only half of the slip should be actually taken. The slip, of course, is not registered and that amount signifies the slowness of the meter. The index is geared to register the actual mathematical measurement of the chambers with correction to counterbalance partially the amount of slip as found by the test.

The experience gained during tests by the Authors is that the meter registers approximately 0·6% faster at capacity than when working at 20% of its capacity. At one fifth of its capacity downwards, the slip curve increases rapidly. If a test against another meter be desired it should be compared at a higher speed to give more satisfactory results.

Steps to be taken are as follows:—

(1) Ascertain differential pressure by means of an inclined gauge at, say, 100,000, 150,000, 200,000, 250,000, and 300,000 cu.ft. per hr.

(2) Close the inlet and outlet valves.

(3) Remove the spring from the hand wheel to allow the wheel to be engaged into the impeller shaft.

(4) Turn the hand wheel in anti-clockwise direction, fast enough to maintain pressure loss, and note the time taken to one fifth of one second, to complete a revolution.

(5) Ascertain any error as in Example 1.

Example 1.—Known Factors

Loss of pressure at 250,000 cu.ft. per hr.	7·5 tenths
Capacity per revolution	16·856 cu.ft.
Index geared to allow for error of	0·363%
Time taken to complete three revolutions of hand wheel, maintaining 7·5 tenths loss of pressure	1 min. 12 sec.
Time taken to complete one revolution of hand wheel or displacement of 16·856 cu.ft.	24 sec.

Therefore, cu.ft. per min. slip $= \frac{16{\cdot}856 \times 60}{24}$

Half slip then is $\frac{16{\cdot}856 \times 60 \times 1}{24 \times 2}$

Same loss of pressure as when passing 250,000 cu.ft. per hr. or 4,166·66 cu.ft. per min. Therefore percentage slip

$$= \frac{16{\cdot}856 \times 60 \times 1 \times 100}{24 \times 2 \times 4{,}166{\cdot}66}$$

$= 0{\cdot}505\%$ slow

Less amount taken care of in index gearing ...	... 0·363%
Meter error ...	... 0·142% slow

Maintenance of Station Meters

A record card is kept for each meter and the visits are entered thereon, showing result of inspection and attention.

BELL METERS

Weekly.—Grease lubricators and pump rods. Note oil level. See that oil being pumped from spout and general circulation are correct.

Monthly.—Drain tap on small oil-filter box. Inspect index, index stuffing gland, pump gland, self-acting overflow, differential gauge.

Half-yearly.—Change thermometers. Clear large oil-filter box.

ROTARY METERS

Weekly.—Maintain oil in bearing.

Half-yearly.—Change thermometer. Inspect index.

CONNERSVILLE METERS

Weekly.—Note level of bearing oil. Fill lubricators. Note differential pressure loss and speed.

Monthly.—Oil index shaft and countershaft. Change gear oil if necessary.

Half-yearly.—Change thermometers. Wash impellers if necessary.

WET-DRUM METERS

Weekly.—Note inflow of water. Note position of water line. Note pressure on self-acting overflow.

Monthly.—Give turn to bearing lubricators. Inspect index stuffing glands.

Half-yearly.—Change thermometers. Inspect condition of emptying cock, of filling pipe, of gauge cocks, of gauge glass, of differential cocks, of differential glasses, of index.

Domestic and Industrial Consumers' Meters

Birmingham has approximately 345,000 domestic and industrial consumers' meters on the district, and they vary in size from 30 cu.ft. to 60,000 cu.ft. per hr. capacity. All types are used and are chosen to suit individual circumstances and requirements. They include prepayment, compensator, and ordinary wet meters; prepayment, ordinary and self-emptying drain-dry meters up to 30,000 cu.ft. per hr.; with Bell, Connersville Tandem, and B. and M. meters for some of the larger consumers.

During the pre-war normal years, in an endeavour to keep reasonably accurate measurements, the records of these meters were methodically reviewed and dissected for the purpose of testing *in situ*. For every meter on the district a life-card is in existence recording full description, capacity and maker, age, where and when fixed, date and extent of repairs. Each card is filed under Corporation number and in size classification.

Meters of more than 700 cu.ft. per hr. capacity were tested every 12 months; between 450 and 700 cu.ft. inclusive, in alternate years; 150 and 250 cu.ft., after being on the district more than five years. Smaller sizes were tested in age groups. Ordinary dry with more than 10 years' service were tested first; then seven to 10 years, then more than five years; five-light prepayment meters of more than seven years, and then five to seven years' use, were tested last.

Meters of sizes up to and including 700 cu.ft. per hr. were tested up to their badged capacity and on a low consumption test, where possible, to a revolution of the test circle.

Meters shown to be defective were changed. Such meters when brought in were checked against the prover, and, generally speaking, the results were confirmed. For the smaller meters a simple method was adopted by using a tester which comprised a rail of six governor burners each burning 2 cu.ft. per hr. and in which one or all may be used. The outlet of a dry meter was disconnected and the tester fixed to the outlet connexion, gas was turned on and observations made. The larger sizes were tested against a 250 or 700 cu.ft. per hr. self-emptying

ELEVATED DEEP PURIFIERS

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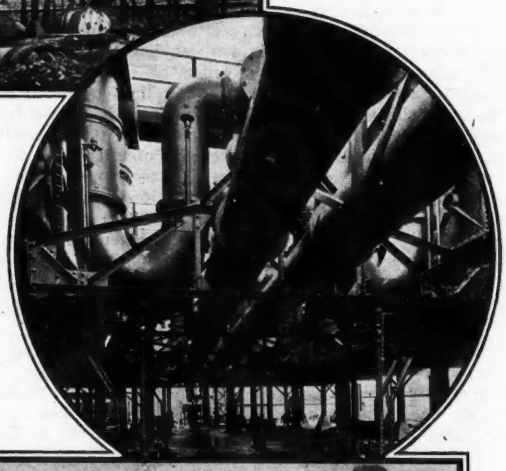
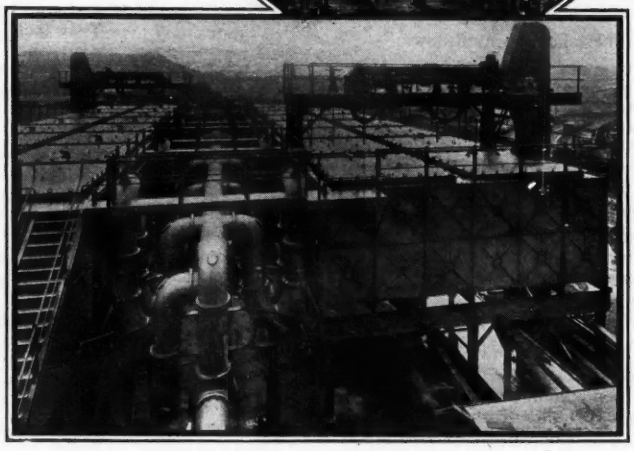


As specialists in Purifier design, we have given considerable attention to this type of installation, and have built many such sets.

We illustrate a contract comprising 8 Boxes, 30′0″ × 30′0″ × 10′0″ deep on Steel Structure, with our Combined Travelling Oxide Plant and Cover Lifting Gear.

Top: General view. (In background, Gas-holder also erected by us.)
Inset: Showing Connections.
Bottom: Overhead view.



These Purifiers designed for a gross capacity of 8,000,000 cu. ft. of gas per day.

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drain-meter, specially constructed in the Department's own shops for the purpose.

The self-emptying drain-meter is, as the name implies, a dry meter which is designed to prevent any condensate from accumulating in the meter. The general principles of an ordinary dry meter are found in the S.E.D. type, the main difference is in the design and position of the valves. They are piston-type valves situated underneath the measuring chambers, and allow any liquid to pass through them and away to the inlet. The inlet and outlet connexions are positioned at the sides, near the bottom. It follows that this type of valve stays in position irrespective of uprightness of the meter (so necessary with ordinary D. slide valves), so the S.E.D. type was chosen as being more suitable for transporting. These were checked frequently against a test-holder before being used.

Many of our larger flanged meters on the district have been provided with a testing plug on the outlet neck, to enable connexion to be made to the test-meter. The outlet of the test-meter is connected to a rail by which up to 700 cu.ft. can be burned, depending upon the size of test-meter used.

Nearly 100,000 meters were tested in the nine years before the war, of which about 9% required changing. Unfortunately, this system of *in situ* testing has had to be abandoned, because of shortage of labour, but it is hoped to re-institute it shortly.

For any system of *in situ* testing it is essential to keep meter records in such a way that meters can be tested in age groups. Much time can be wasted and no useful information gained if testing is carried out road by road without reference to the age or type of the meter, and the averaging of results obtained from such methods may easily lead to unwarrantable inferences being drawn. If, however, the testing be carried out methodically, according to size and age group, old and defective meters are gradually eliminated and useful data as to the average life of different types of meters is obtained.

Measurement of Gas Used for Public Lighting

Prior to the outbreak of war the charge for gas consumed by public lamps was based on the readings of 440 "lamp" meters fixed in or at the base of selected lamp columns. This method, though it continued in use for many years, was never entirely satisfactory, and inexplicable differences in registration occurred which made agreement on average figures for different types of lamps and different lighting and extinguishing times very difficult.

Under the terms of the lighting contract the supply and maintenance of these lamp meters were the responsibility of the lighting authority, not of the Gas Department, and towards the end of the war it became obvious that extensive renewals would be necessary.

The problem was considered by the City Surveyor and the Authors in 1944, and it was agreed that the use of lamp meters on the district should be discontinued. In their place two batteries of lamps and meters were installed, one at the City Surveyor's Public Lighting Depôt, and a replica on the Gas Department's premises. These standard lamps correspond to the lamps actually fixed on the district and are fitted with fixed nipples, controllers, and governors. It was further agreed to standardize on fewer types of lamps. This suggestion was acted upon, and when lighting was restored in August, 1945, these two installations were put into commission.

Each standard lamp is connected to a 5-light dry meter, and weekly statements are taken. The lighting and extinguishing of the lamps correspond to the normal street-lighting schedules, and in each case the night-duty men inspect at lighting, checking and extinguishing times to see that all is in order. Lamps failing to light and extinguish are reported and immediately dealt with by the night fitter.

The consumption figures obtained are compared each week, and any serious discrepancy is at once evident. The meters themselves are periodically examined and tested in the meter shops. As an additional safeguard, a check is made at intervals by working out the consumptions based on the hours of lighting multiplied by the actual consumption of the lamp, plus the bypass consumption.

Each installation now consists of the following lamps:—

(1) 1-light No. 2 Square Lantern with comet.
(2) 2-light " " " " "
(3) 3-light " " " " "
(4) 4-light " " " " "
(5) 6-light " Suspension Lamp with bypass checking to 2-light at midnight.
(6) 8-light No. 2 Suspension Lamp with bypass checking to 2-light at midnight.
(7) 8-light " " " with bypass checking to 4-light at midnight.
(8) 1-light " Traffic Lamp with bypass.

Because of the restrictions imposed on local authorities concerning lighting since September, 1945, a large number of lamps, particularly the square-lantern types, are now extinguished at midnight. The consumptions of these lamps are arrived at by taking a proportion of the all-night registered consumption and adding an agreed bypass figure. The gas consumptions on the installation at Lord Street are charged each quarter to the Public Lighting Department.

At the end of each quarter, representatives of the Gas and of the Public Lighting Departments meet and agree on the consumptions, which are then passed to the rental section for charging against the lamp statement supplied by the Public Lighting Department.

Unaccounted for Gas

The difference between gas registered by the station meter and a total registration of all consumers' meters is usually somewhat loosely spoken of as unaccounted-for gas.

A report by the Sub-committee on Unaccounted-for Gas of The Institution of Gas Engineers was presented to the 10th Autumn Research Meeting of the Institution in November, 1938. This stresses the need for obtaining accurate registration and correction at the station meters, and it is comparatively easy to keep these figures on a sound and logical basis; but when one seeks to compare these figures with the total gas sold to individual consumers it is by no means easy to arrive at a figure similarly corrected.

If one remembers that the gap between station meter readings and the total of consumers' meter readings is composed of several factors which are to a large extent calculable, then the volume of gas actually unaccounted for is considerably reduced. The most important of these factors are as follows:—

(1) Temperature.
(2) Pressure.
(3) Meter inaccuracies.
(4) Leakage from gasholders.
(5) Leakage from mains and services.
(6) Errors in estimation of gas for public lighting, &c.
(7) Inability to read all meters simultaneously.

From a practical point of view special attention should be paid to those factors which, if minimized, will increase the amount of gas sold.

(1) *and* (2)—*Temperature and Pressure*

Of these, temperature is by far the more important. Experiments carried out by Mr. R. G. Marsh, of Birmingham, in 1928-29 showed the following temperatures on a normal factory meter.

Meter on test.—2,000-*light cylindrical wet.*

Month	Gas in main (°F.)	Gas in meter (°F.)	* Earth temperatures (°F.) At 1 ft.	At 4 ft.
October	52.0	52.7	49.5	51.6
November	47.7	48.6	46.3	57.3
December	42.2	43.5	41.4	46.7
January	37.8	40.9	34.3	43.4
February	36.8	40.0	36.7	42.2
March	35.0	42.6	40.5	44.8
April	43.0	50.5	43.3	44.3
May	49.1	55.7	47.8	45.9
June	55.9	60.5	52.2	49.5
July	59.9	64.2	56.2	52.0
August...	57.1	64.3	54.9	53.2
September	53.1	62.0	57.1	54.6
Average for 12 months ...	47.4	52.1	46.6	48.8

* Earth temperatures supplied by Meteorological Observatory.

As more gas will be sold during the winter than the summer the figure of 52·1° F. is probably somewhat higher than the true average, and with station meter readings corrected to 60°F., almost 2% of unaccounted-for gas may easily be due to this cause alone. In practice, all that can be done to reduce this figure is to see that meters are fixed in well protected positions, free from draughts, and not subjected to extremes of temperature.

(3).—*Meter Inaccuracies*

Loss from this cause can be minimized by *in situ* testing, intelligent noting by meter readers of cases of doubtful registration, and avoidance of overworked meters. Care should be taken to see that dry meters are always fixed in such a way that there is no possibility of condensation draining back into them.

The Authors' experience with *in situ* testing was that the number of fast and slow meters tended to cancel out each other but it must be remembered that the official tolerances are weighted 1% against us. Inaccuracies in meter registration are not the sole cause of unaccounted-for gas, but meters must be given a fair chance of preserving accuracy by sensible fixing, and correct estimation of load. One feels that in some undertakings meters are not always treated with the respect to which their construction and value entitles them.

(4) *and* (5).—*Leakage from Holders and Leakages from Mains and Services*

Except in special places, such as mining areas, the loss due to these causes is not normally great, and experiments carried out by the late Stephen Lacey pointed to a figure of just under 1% as being the likely maximum in a well maintained undertaking.

(6).—*Errors in Estimation of Gas Used for Public Lighting*

This item has been dealt with in an earlier paragraph in this Paper.

(7).—*Inability to Read All Meters at Same Time*

Although it is easy to give the actual amount of gas registered by station meters between two fixed dates, the reading of consumers' meters is a continuous process and on any one day there is a varying amount of gas registered but not read which cannot appear as a book figure. This necessitates the inclusion of an estimated consumption in striking a balance.

One Further Step

The early part of this Paper stressed the importance of gas measurement as ultimately determining revenue. The popularity of the automatic meter has increased in recent years. In Birmingham, approximately two thirds of domestic meters are prepayment, and one third of total gas sold is measured through them. Whereas in the past the single-coin (penny) meter met all the needs of these consumers the change in values during recent years has resulted in a demand for a two-coin (penny and shilling) meter; and to-day all prepayment meters purchased are of the two-coin type. Sufficient experience has now been obtained and no one can deny that their adoption has meant greater expense to the Industry. It is only to be expected that a more complicated mechanism will result in more costly maintenance. From their experience the Authors submit that, by and large, the beginning of most of the troubles in prepayment meters is the presence of the auto valve.

There is no doubt that the primary cause of the majority of complaints in prepayment meters with which the Industry has to contend to-day, particularly since two-coin meters have been introduced, is the imperfect closing of the auto valve.

The makers have produced a very efficient auto valve closing device, but when it is subjected to district conditions, circumstances arise beyond control, such as dust or particles of rust entering the valve chambers. For many years troubles have been experienced with meters because of imperfect closing of the auto valve button. If the valve does not seat perfectly for any reason, gas can still pass beyond its predetermined limit and as a result a strain is put on the meter or prepayment mechanism, resulting in either breakage or "creep" and the complaint consequent upon it. Generally speaking, such meters have to be changed. In some two-coin meters, the resistance to closing the auto valve is greater than that of the mechanism gearing, and the gearing creeps.

Without elaborating too much on these troubles, a few of the complaints received might be mentioned, as follows:—

Cash, Short, or Auto Valve Not Closing.—Usually following a strain upon the auto lever; the setting position becomes upset, allowing gas to pass the button without the need to use coins to open the valve.

Coins Sticking, or Coins Not Entering.—In some meters when a strain is put upon the mechanism the gearing creeps and the retaining pawl rides on the coin wheel: in others the friction plate allows the coin wheel to move slightly, causing the carrier engagement point to foul the wheel. When an attempt is made to insert the coin, instead of finding its relative position the impeded engagement plate obstructs the coin entrance.

Out of Gear in Top.—A gas pressure of 5 in. upon a pair of diaphragm leathers throws considerable strain beyond the crank if there is any resistance such as would apply when the prepaid limit is reached and the gas does not shut off completely. Usually a soldered connexion breaks, or a worm is forced out of gear or churned away to release the strain, sometimes preceded by a complaint of "binding in top," "jumping lights," or loss of pressure.

Complete Failure to Register.—This will be the result should the cross-shaft from the centre crank to the index be the weakest point and break away or become out of gear with the worm.

Repair troubles directly due to auto valves are as follows:—

Rust accumulates from service, causing:—
- Button not to seat,
- Corrosion of box bottom (very difficult to repair), or
- Spindle to rust in the stud.

Valve button not shutting off:—
- By reason of rust or foreign matter obstructing it,
- By reason of button not moving back squarely (corrosion of ball joint), or
- By reason of leather face going hard.

On a two-coin meter, insertion of one penny opens the valve one twelfth the distance opened by a shilling, giving a very small opening of the valve for pennies, causing the complaint that gas cannot be obtained for one, two, three or four coins.

It is in an attempt to overcome the primary cause of these troubles that the Authors have designed a meter to eliminate the use of the auto valve completely.

Non-Auto-Valve Meter

To enable this to be done the ordinary valve of the meter, which controls the communications between the gas inlet, the diaphragm chambers and the gas outlet is utilized to prevent the passage of gas when the amount of gas prepaid for has been supplied. The usual mechanical driving connexion between the diaphragm leathers and the valve covers is interrupted and a resilient connexion is introduced between them at the crankshaft and the crank is made independent of the top arms and the flag wires. When the prepaid gas has run its course an arrest of the valve covers takes place at a particular point, but the driving part continues to move because of the inserted resilient coupling, until the gas admitted before the arrest took place has been passed through the outlet. In this manner the diaphragms are thrown out of phase with the gas valves.

The arresting device is freed by the insertion of another coin in the prepayment mechanism; the resilient connexion simply returns the valve covers to the normal timed relationship and gives at once a full passage of gas. When the arrest takes place there is a clear passage for gas to enter the leather chambers, and gas being expelled by the pressure continues to be so until it has become exhausted.

The position chosen to arrest the covers is when there is little or no movement on the front top arms, the inside leather being almost empty: the back top arm continuing its forward stroke, the back leather empties and the case fills. The position then is that the two outside chambers are full of gas: the inside chambers are empty, with no communication between the two, and the supply fails.

At the shut down position the diaphragms are acting in opposition to one another against rotation of the tangent with the spring making a small contribution to the front leather. The forces are not quite balanced, consequent upon a difference of lever arms on the two top arms. There is a stress of approximately 4 lb. per sq. in. thrown on the spring to open it half an inch. The meter then comes to rest.

Each leather now has one-sided pressure upon it and at, say, 5 in. or 0·18 lb. per sq. in., it would be about 14 lb. on the size of the leather used in consumers' meters. When the valve covers are released the spring immediately replaces them in their proper position; the full chambers are in communication with the outlet; there is a clear passage for the inlet gas to pass to the empty chambers, and so the pressure can again start the meter working and with an immediate full opening.

The spring, which is made of Staybrite steel, is strong enough to overcome the gas pressure on the two valve covers and is able to transmit the normal drive.

The Arresting Device.—When the rotations of the crankshaft corresponding to the delivery of the amount of gas for which a coin has been inserted have taken place, the horn of the cam operates the lever to which a pivotal pawl is attached. The slightest touch on the pointed leading end will rock back the pawl and raise its operative until held rigid by the tail. This is weighted to return it to its original position when again released.

About 100 meters have been working on the district in Birmingham, and there have been no complaints and no faults

revealed of the new construction as shown in Fig. 1. Collections have been made regularly from each meter with remarkably accurate results.

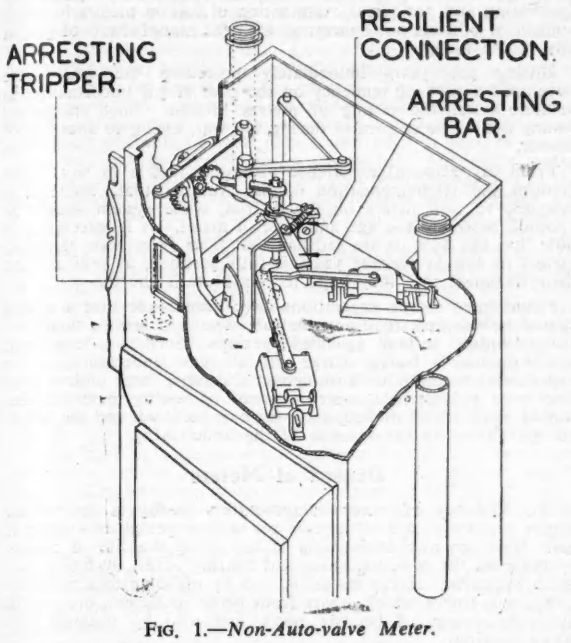


FIG. 1.—*Non-Auto-valve Meter.*

It is realized that the leathers are subjected to one-sided pressure when the arrest is made, but it is felt that such parts which may bear the extra strain, which is not excessive, can be taken care of and that the advantage of eliminating the auto valve far outweighs what may be considered a disadvantage of pressure on the leathers.

The sudden closing down of the meter may have been a disadvantage in the days when lighting was predominant, but as gas is now used mainly for heating there seems to be no express necessity for the warning of failing supply; this is borne out by the lack of even a single complaint from our consumers.

The advantages are summarized as follows:—

(1) Elimination of the auto valve and all the trouble it brings.

(2) Action being instantaneous, and limit of travel constant, cash and gas must agree.

(3) Definite and immediate full opening when first coin is inserted.

(4) Opens with first coin, even with a penny, on a two-coin meter, even when set low.

(5) Elimination of the stuffing box.

(6) Eliminating any possibility of strain on the prepaid mechanism will give much longer use, even probably beyond the life of the meter proper.

(7) Closing or opening spring is neither used nor necessary.

(8) Body of meter may be built for use as an ordinary meter or prepayment meter.

(9) Falling off of pressure on last coin is avoided.

(10) Considerable saving of time when testing for cash and gas and closing of auto valve.

(11) Testing on the district for registration of small consumption is much simplified. The tripper can be raised, and if any gas can be burned above the statutory limit the meter registration is defective.

(12) The meter so fitted should require less attention on the district, should not return so frequently for repair, and when home for repair requires less labour because it has no auto valve box for cleaning, repair or setting.

(13) Does not disturb makers individuality in attachments, and generally can be readily adapted.

Discussion

Mr. **Spinks** said that since this Paper was submitted, an excellent Paper by C. D. Shann, Assistant Distribution Engineer of the Gas Light and Coke Company, had appeared in the Press in which the possible causes of differences in the quantity of gas made and gas sold were set out most clearly and in great detail. That Paper suggested that 2% or even 3% of unaccounted for gas was probably due to differences in temperature and pressure of the gas as metered by the station meters and by the consumers' meters.

Mr. **J. T. Haynes** (Chairman, Meters Committee): Birmingham has an honoured place in the British Gas Industry, not only as the largest of the municipal undertakings, but also as one which has consistently directed technical control by means of scientific investigation. Birmingham is also outstanding because of its readiness to put its tremendous facilities at the disposal of other undertakings. On several occasions I have had the benefit of such assistance, and I would like to pay tribute to such men as Dr. Walter, Mr. Hems, Mr. Spinks, and other members of the Birmingham Gas Department.

The Institution encourages the presentation of Papers on technical subjects covering the whole range of gas engineering, but it is only at rare intervals that we have a Paper dealing with the humble gas meter, and I welcome this one by Mr. Spinks and Mr. Mason for, as things are, without the gas meter the revenue of every gas undertaking in this country would be an indeterminate quantity.

It is because of this importance of the domestic meter that I am inclined to dispute the order of priority named by the Authors. The works "station" meter is only one of the instruments used by the works engineer to assure himself that the plant under his charge is being operated efficiently and its accuracy is no more essential than that of the many other appliances used in works technical control. The consumer's meter, on the other hand, is the only safeguard of the revenue of the undertaking and if, in Birmingham with all its scientific control, 9% of the domestic meters were found to be faulty what must be the position in those Undertakings which have never conducted "in situ" testing of consumers' meters? Even if the errors in registration—fast and slow—tend to cancel themselves out as the Authors suggest, one cannot feel very satisfied with a boasted efficiency of gas production which stops short at the boundary walls of the gas-works.

Recommended Test Methods

The Institution, through its Gas Meters Committee, has realized this danger and has advised all undertakings to institute "in situ" testing of consumers' meters, and has issued recommended methods of conducting such tests, emphasizing that the inaccuracy of consumers' meters affects the balance sheet. The gas meter is also a determining factor in the degree of goodwill and confidence which the public has in the integrity of the Industry; its accuracy is therefore essential.

A number of gas undertakings made "in situ" tests before the war and the information gained has been made available to the Institution. The tests had to be suspended during the war, and now that they have been recommenced, the results indicate how unsatisfactory the position must be over the country as a whole. The main causes of the deterioration in the accuracy of registration by consumers' meters would appear to be in the following order of importance:—

(a) Dirty gas;
(b) bad siting of the meter;
(c) careless transport and fixing; and
(d) age of the meter.

Periodic reverification of meters whether they are accurate or inaccurate would entail unnecessary expense and would not ensure correct registration; old meters could become inaccurate soon after being refixed in a consumer's premises. The only safeguard is periodic "in situ" testing and the withdrawal for repairs and restamping of all those meters found to be registering incorrectly. Whether such testing is based on the age of the meter in service or on a house-to-house method to economise labour is of less importance than the determination to institute a testing system at the earliest possible moment. I cannot emphasize too strongly the need for this.

Prepayment meters are notoriously liable to give trouble, but by far the most frequent complaints have nothing to do with registration. They relate to the prepayment mechanism and most can be traced to the automatic gas valve which shuts off the supply of gas when the prepaid coins have been used up.

Bournemouth Consumers Satisfied

The Birmingham Gas Department have understood their responsibility in this matter and with a view to retaining the goodwill of their consumers they have endeavoured to minimize the troubles due to these purely technical difficulties. The Authors

describe in some detail one of their efforts in this direction—the Non-auto-valve prepayment meter. They are to be congratulated on so successfully cutting out one of the most serious causes of complaint by consumers. A number of these meters have been on test in Bournemouth and in every case the consumers—without knowing anything about the mechanism—have declared themselves as satisfied. The collectors report that the cash in the meter boxes is invariably correct with the gas registered, and we have every reason to think that the claims made for the mechanism can be substantiated. But do not be misled. The claims do not say that a pilot jet will remain alight indefinitely after the prepaid gas has been used—the gas supply is definitely cut off, and this leads to other difficulties of a different nature.

But this is not a Paper on meter troubles; it is a note of thanks and congratulations to the Authors of the Paper who finish off with a mild apology—for using a rotary meter to test the station meters. Surely no such apology is necessary—it is almost an insult to the highly satisfactory rotary meter—I would have preferred them to say: "There, that is what we do in Birmingham. Beat it if you can!"

Mr. **R. J. Rogers**: The Authors are to be congratulated on presenting this Paper, which outlines many aspects of gas measurement, all of which are of the greatest interest to all gas undertakings, and to the manufacturers of gas meters. It is apparent from the Paper that the Birmingham Gas Department has, for many years past, devoted considerable attention to the correct metering of the gas they manufacture and distribute to their consumers, and we shall all agree with the Authors' statement that "The paramount importance of correct measurement by consumers' meters and by station meters cannot be overestimated."

The value of the Paper is enhanced by the fact that the Authors have outlined their views on the various types of station meter which are in use in this country, and of which they have had practical experience in the different works of the Birmingham Gas Undertaking. Their descriptions of the limitations and advantages of each type used, and the principal points which may lead to incorrect registration and which require special maintenance, will be particularly welcomed by all engineers who are responsible for the registration of the make of gas.

Although, by reason of its bulk the wet drum station meter is now being replaced by types of station meters occupying less space, it must be borne in mind that the wet drum type may be relied upon for accurate measurement, and in this respect will be found difficult to surpass.

Provided reasonable care is given to its maintenance it will give good service over a long number of years.

The rotary meter forms a very convenient method of gaseous volume measurement. It is simple, and probably one of the smallest meters for measuring large flows. The rotor determining the velocity of the gas emitted from the jets integrates volume to a very accurate degree, within ± 2% down to 10% of capacity, and it is quite possible to reduce this capacity down to 5%. The energy required from the gas to supply the meter is a very low figure, and in consequence the meter should be able to function at capacity of not more than three-tenths water pressure loss.

Although on inferential meter, its accuracy approaches more nearly to the positive meter than does the majority of inferential meters, and it has a major advantage, in that it measures the volume passing through the meter regardless of the relative density and/or pressure of the gas within wide limits. To clarify this, one might consider that if the rotor and index friction is zero, it is almost true to say that only velocity governs the rotor speed, and mass has no influence: thus, where the friction is very low, the effect of mass is almost negligible, and does not noticeably affect the registration of the meter. This feature, together with the simplicity of the meter, allowing a wide choice of manufacturing materials, has widened its value to outside the Gas Industry, and it has found favour in measuring ammonia, chlorine, carbon dioxide, sewage gas, and many others.

The capacities relative to meter sizes are very flexible, so that each meter can be considered in the light of the requirements, the jet velocity, fan speed and gearing being arranged to suit. Being a very simple meter, service, inspection, and maintenance is quick, and the use of the meter is advantageous in cases where considerable depositions are expected. Having regard to its comparatively small size, and its accuracy in measuring large flows, it is surprising that this type of meter has not been more largely employed as a station meter for gas-works.

Testing of Birmingham Station Meters

Some gas undertakings have systems of periodical testing of their station meters, but I think it is true to say that many gas undertakings do not devote sufficient attention to the checking and maintenance of this important piece of apparatus, which so vitally concerns the economics of gas production. The method of testing station meters in Birmingham, as outlined by the Authors, is one which might be usefully employed by large undertakings, and the details given on testing procedure will be most helpful. There is one aspect of testing station meters in Birmingham not mentioned by the Authors, and that is the responsibility for testing and periodical examination of station meters is in the control of officials not concerned with the manufacture of gas on any of the works.

During the years immediately preceding the war, there developed a growing tendency on the part of gas undertakings to institute systematic testing of meters in situ. Such periodical testing had to be suspended during the war, owing to shortage of labour.

From my personal experience of testing meters in situ, I can confirm the recommendation of the Authors that, where it is intended to test meters on the district, some system should be adopted based on the age and type of meter. It is interesting to note that the Authors are satisfied that their experience of testing meters in situ in pre-war years is fully justified, as indicated by their statement that they hope to reinstitute it shortly.

From time to time suggestions have been made that a statute should be adopted, requiring that all meters in service should be tested within certain specified periods. Such an enactment would impose a heavy charge on all gas undertakings. The experience, therefore, of Birmingham and other large undertakings who have voluntarily adopted systems of testing meters in situ should be carefully studied, as to the cost incurred, and the results of registration on the revenue of the undertaking.

Design of Meters

The tendency of meter manufacturers to-day is to produce meters smaller in size, with more revolutions per given volume of gas. Research and engineering is increasing the life of meters, by reducing the pressure losses and bearing loads, by fitting very much improved bearing materials, and by reducing to a minimum component forces which, apart from being inefficient, are one of the chief causes of bearing wear, and also by utilizing well fitting bearings.

It is generally accepted, as pointed out by the Authors, that auto valves are the main trouble in pre-payment meters, and directly or indirectly may be responsible for more than 70% of the complaints. Any improvement, therefore, which is likely to minimize the complaints arising from the use of the auto valve should be given every encouragement and consideration, and the Authors are to be congratulated on the efforts they are pursuing in the design of the non-auto valve meter, which has been given a district test in 100 meters in the Birmingham area.

The advantages claimed by the Authors commend themselves to all interested in the design and use of pre-payment meters. Actual district experience alone will prove the advantage or otherwise of the meter, as compared with meters of the traditional pre-payment type fitted with an automatic valve. The principal disadvantage is that the diaphragm is subjected to unusual strain, which designers of pre-payment meters in the past have carefully avoided.

It is interesting to remember that one of the earliest methods of shutting off the gas to a pre-payment meter was by putting a lever in the path of the tangent, but owing to the stresses thrown on to the diaphragm and all the parts to the tangent, this method was considered unsuitable, and replaced by the auto valve.

From a study of the mechanism of the non-auto valve meter, it would appear that leathers would have to withstand an excessive amount of pressure, and although in most meters liberal safety factors are employed, the stresses set up when the arresting device comes into operation may be found to be too great. As one who was previously in charge of the Meter Department of the City of Birmingham Gas Department, I should like to express my sincere appreciation to my former colleagues for having placed at the disposal of the members of the Institution their experiences with the measurement of gas in this City.

Departure from the Orthodox

Mr. **B. R. Parkinson**: Having had the privilege of close association with the Birmingham Gas Department for many years, may I pay a tribute to their originality and independence in matters concerning the measurement of gas. They have always gone their own way and one cannot recall any occasion when they were not right. The employment of a rotary, that is, an inferential meter, to test the old positive drum type of wet meter was a most startling departure from the orthodox. At the time it put a severe strain on the modesty of the manufacturers of the rotary meter. In fact, such was their difference that they depreciated my writing it up for the Gas Press and the articles which I prepared at the time is still lying in my archives.

The rotary meter is not used here as a standard, but as a medium, on account of its portability and high speed. Never before had the old wet station meters been tested at speed, and

no one knew, except theoretically, what measure of accuracy they gave when in fuh operation. With the water line set for accuracy at a measuring rate not exceeding 600 cu.ft. per hour, the great big meter was expected to register accurately at any rate up to 300,000 cu.ft. per hour with all the hazards of the water level dependent on changes in driving pressure. There is no doubt (I say again theoretically) that, given attention to the water line under the varying conditions, a good measure of accuracy could be attained, but no one knew for certain. The Birmingham Gas Department were determined to make some effort, if only at 50,000 cu.ft. per hour, and they employed a portable rotary meter. Here is an example ot what they found out. It may be exceptional, but only by the test was it discovered. They were testing a new large wet station meter which had been duly proved in the usual manner at slow speed by the makers with a small wet test meter. The rotary meter, at 50,000 cu.ft. per hour, showed it to be 4% slow. This test was repeated with the same result, and the rotary meter was sent to the makers for recalibration. On return the same result was obtained, and the rotary meter was confirmed in its accuracy against another wet station meter. Eventually after research it was found that gas was passing to the wet station meter from a blower that had a narrow vertical outlet. Condensation from the gas was flowing back and choking this outlet, causing violent oscillation in the meter. The remedy was very simple, just to tap the outlet of the blower and provide a getaway for the water. Then the new station meter was again tested and this time found correct against the rotary. This incident occurred in the earlier stages of the Gas Department's pioneer work in building up a technique for proving all its meters. The complete system as set out in the Paper is of the greatest importance to all who value correct measurement in the Gas Industry. Incidentally, as a matter of interest and some surprise, the rotary meter is also independent of specific gravity.

I was a little puzzled at the Author's experience of strolling about inside a large station meter drum. This must evidently have occurred during construction and before the meter was in use. To do that after it had passed gas, with possibly a touch of naphthalene, would be certainly an unforgettable experience, especially in these days of clothing coupons.

Creatures of Habit

But before leaving the old meter, I would mention that it was the Birmingham Gas Department who first ran the Crosley drum backwards; this was on the initiative of the late Mr. Chas. Hunt, of whom I had the honour to be a pupil at Windsor Street Gas-Works. These meters were actually installed before I started and I believe are still working backwards. That device makes for greater accuracy in the water level with varying speeds. Through all these years it has never been adopted until recently by Professor Boys and Major Hyde in their small test meters.

If the Birmingham Gas Department were the first to run their wet station meters backwards, they were also the first to run dry meters up-side-down, or rather to design a meter with the connexions underneath instead of on top. This is, of course, the correct way for dry meters. Connexions on top were a relic of the old wet consumers meters where condensation from pipes and fittings was expected and invited to return to the meter. Now that is the very last thing desired. We are strange creatures of habit.

The Birmingham Gas Department were also first and alone in making a success of the Bell meter which is the most accurate of all station meters. They appreciated its principle and determined to give it a fair chance. But this meter, although taking up less room than the Crosley drum also belongs to an epoch that is passing. This does not by any means exhaust the record of pioneer work for which The Birmingham Gas Department has been responsible. I have referred to my long association with them, now extending to 56 years, and am glad to have this opportunity of paying my compliments not the least of which are due to its present Engineer.

Code of Good Practice

Mr. **C. F. W. Rendle** (Redditch): The measurement of gas volume is fundamental to a great deal of a gas engineer's business in production, distribution, and supply, and accuracy is necessary for the efficiency, if not the success of his enterprise. Reliance upon incorrect data merely invites illusion and insecurity. This Paper, therefore, is to be appreciated by works and distribution engineers alike and especially by those of us whose duty covers work in both fields.

The code of good practice established by the very large gas undertakings—so freely placed at our disposal—has long been regarded as a model to be scaled down and adapted to the needs of the thousand and one smaller undertakings which form the fabric of the Industry and an example is given of this co-operation in Section VII, which describes the method employed in Birmingham before the war for dealing adequately with consumers meters on the district. If the Authors could amplify these details I think it would be of added advantage to many of us. May we ask, for example, what percentage of the consumers' meters tested in situ at the scheduled periods were found to be detective, and, secondly, what percentage of consumers' meters examined as a result of specific complaints from sources other than the scheduled examination were found to require repair and adjustment?

I concur with the Authors' appreciation of the B.M. meter, but I would add to their remarks by advocating the periodical examination of the bevel drive which actuates the integrator. Experience has shown the possibility of partial and even complete disengagement of the bevel gears caused by wear of thrust faces when the meter is working well up to capacity. Complete disengagement is readily observed, but partial disengagement resulting in slow registration is possible. Periodical inspection of the drive on larger meters of this type is a wise procedure. My experience has also revealed the propensities of this meter as a Benzole Scrubber in a similar degree to that found by the Authors, but I hold the view that saturation of the oil does not occur for such a long period of use that the process is almost continuous.

The extensive treatment of station meter testing is of great interest and together with some subsequent sections of the Paper may be regarded as somewhat of an Appendix to the 1938 Interim Report of the Research Sub-Committee on Unaccounted-for Gas. So far is this suggestion from any inferred discourtesy that I intend it as being complimentary to the Authors for calling attention to the value of this Report. The period of war immediately following its publication has probably retarded its wide adoption in a marked degree, which emphasizes the timely reminder afforded by this Paper.

Errors of Volume Estimation

In the early days of the Midland Consultative Emergency Panel whose work preceded the establishment of the Gas Engineering Advisory Boards, we attempted to assess what is now known as the F.E.I. of the Region. Some of the data endorsed upon questionnaires gave rise to such extraordinary results that upon examination we concluded that they arose from errors of volume estimation. I remember that our President, himself a member of the Panel, was convinced that some of the vagaries were due to inaccuracy of station meter registration. The question of using a mobile testing unit similar to that described by the Authors was reviewed and in my opinion its usefulness still exists, and should be examined. The financial outlay upon this equipment by every undertaking is unjustified because of its infrequent use. The same purpose can be achieved by the use of fewer testing units owned collectively by a group of undertakings in a similar manner to that successfully adopted in the Midlands for the purchase of mobile purging machines. I expect that a good many of us are trying to remember when our station meters were last tested, since hearing of the Authors regular testing in Birmingham.

The Midland Panel at the same time was surprised at the absence of uniformity in the methods employed for the correction of gas made; some used the standard of 60° F. and 30 in. Hg., and ignored gas pressure at the metering point; others, like Birmingham, used another standard based upon determined local average atmospheric conditions, and some made no correction whatever. I do not know the extent to which this vagary exists throughout the country, but its existence is proof of the desirability of wider implementation of the findings of the Research Sub-Committee which dealt comprehensively with the many factors influencing volume correction in the manufacture and sale of gas. This need is the more important because of its bearing upon the F.E.I. by which the processing efficiency of the Industry is at present assessed, and for the following reason. The method employed for the calculation of F.E.I. has regard for the volume of gas made by the undertaking no matter if or how it has been corrected to any standard condition of temperature and pressure, but it ignores the volume of "unaccounted for" gas. For example, the effect of ignoring the total gas pressure at the station metering point is to reveal a lower volume than that obtained by proper correction to standard conditions, and it also suggests fictitiously, as it were, a volume "unaccounted for" reduced by the same amount. The revealed F.E.I. of the undertaking is to this extent being impaired with no balancing credit for the assumed low "unaccounted for." We may resolve this contention into an example and realize its import if we appreciate that an ignored metering pressure of only 4 in. w.g. will result in a revealed gas make which is 1% lower than the properly corrected volume—the equivalent of very nearly one therm per ton of coal carbonized on the average. Moreover, the effect is almost proportionally greater with increased metering pressures within the gamut of barometric conditions usual in this country. If no correction whatever is made to the metered volume the effect may or may not be quite so marked, but under the average mean atmospheric and metering conditions in the country it will be in the same direction, and therefore disadvantageous. As to the effect of temperature which the Authors regard as the most important in the case of sales inaccuracies, it is well to remember

that the effect upon volume of a change of 1° F. is approximately equal to that caused by a variation of 1 in. W.G. pressure, within the normal range of atmospheric conditions.

To those who may be inclined to criticize the academic character of the Research Sub-Committee's methods of volume correction of both gas made and gas sold through consumers' meters, I would submit that by so standardizing, as far as is practicable, the methods of volume determination, of gas made and gas sold, one eliminates the variables of otherwise unknown order which comprise some of the factors contributing to the "unaccounted for gas." This results in an "unaccounted for" volume, comparable year by year, the effect upon which of money spent in dealing with meter (and gasholder!) repairs can be appreciated and more accurately assessed.

The Meaning of Accuracy

Mr. **E. A. Goodland** (Birmingham): This Paper gives an excellent account of what can be done in regard to the accurate measurement of gas and I think the Authors do the best they can under the circumstances. Nevertheless, I rather think, with Mr. Rogers, that the fundamentals of the subject have not been discussed to the extent they should have been and that we are getting a somewhat fallacious idea with regard to accuracy. I take it as an axiom that gas measurement cannot be accurate unless it is carried out under standard conditions of temperature, pressure, and saturation. To talk about a meter being accurate only means that it is accurate under its station conditions, and its accuracy under any other conditions may be completely wrong. It is no consolation to a person to be told that under standard conditions his meter is accurate when under the particular conditions in which the meter is working it is all wrong. It seems to me, therefore, that great improvements can be made in this connexion.

As regards station meters, I should be the last to suggest that you should have a meter and not make it as accurate as you can, and I think that if the procedure described in the Paper is carried out, you should get reasonable accuracy. But would it not be a good idea to try and get every measurement in the works up to the same high level of accuracy that engineers think desirable in the measurement of gas? I regret that the measurement of coal, coke and other products are not treated with the same degree of accuracy as the measurement of gas, or anything like it. Frequently no correction is made for moisture or ash content when calculating the therms yield per ton, and things of that kind, and improvement there is very much overdue.

With regard to consumers' meters, if it is impossible to have each meter corrected—and I rather doubt it—I should say that if the Authors are capable of inventing the non-auto-valve which has been described in the Paper, they should construct a meter which is automatically corrected for temperature and pressure. It should be possible to have meters which are standardized under conditions representing the average conditions on the district, but that is not so at present. How the magic figures 60 and 30 came to be introduced into our reckoning, I do not know, but if they were right at that time, they do not appear to be right in Birmingham now and something ought to be done about it. Furthermore, talking about accuracy of gas measurement, it is rather diverting to read in Field's Gas Analyses figures for various undertakings running into eight or nine significant figures. If you will excuse me saying so, I think that is all "baloney," and should not be tolerated. The average of these figures cannot be greater than the sum of the individual figures composing them and therefore they should not be extended to that degree. I think our friends the accountants must have had a hand in it somewhere. I have read the Report of the Committee on Unaccounted-for Gas and it seems to me that whilst it is useful it hardly went far enough and could be improved upon.

Acquisition to Gas Literature

Mr. **G. M. Gill**: This Paper will be a real acquisition to gas engineering literature, as so far as I can remember it is a very long time since anyone attempted to bring this important matter up to date, and so much has happened in this direction during comparatively recent years. Obviously, so large an undertaking as Birmingham has considerable experience of gas meters of all the various types and the Authors are to be congratulated on putting so much experience into a convenient form for study.

I have been surprised to see so many rotary meters in the list of those used, as this type of meter is not generally acknowledged as reliable, though in one works with which I have been concerned, I was satisfied against my preconceived conception that it was a good and reliable meter. As the Authors point out, the rotary meter must obviously be kept in good and clean condition to do its job properly. Some years ago I was much impressed by the high praise which Mr. Bernard Parkinson, who is a very highly qualified man on meters, gave to the rotary meter. From that time I have always considered it a reliable meter.

I personally have had no experience with the Bell meter, but was interested to see what the Authors have had to say about it. As regards the Connersville meter, I have been interested in this type since I first described it in a Paper which I read before the Southern District Association in November, 1925, and as a result of which this American product was taken up by W. C. Holmes & Co., and developed with great energy.

Incidentally, the idea of using the Connersville type of machine as a gas meter was developed by a prominent American gas engineer named J. A. Brown, who wanted to measure some gas in an experiment, so he converted a Connersville exhauster into a meter and allowed the gas to drive it and then recorded the quantity of gas passed with a revolution counter. He found that his exhauster became in this way quite a reliable meter for the job it had to do. He drew the attention of the Connersville Blower Company to the idea and as a result they developed their machine as a meter and J. A. Brown drew a Royalty on his invention, which was speedily adopted throughout the United States and later here and in many other parts of the world.

In my experience we have had nothing but good service from Connersville meters as made in this country, and in practice, when the meters have become too small for one works, we have shifted them to a smaller works and so far as one can see their life should be a long one. The B.M. meter has, of course, been widely adopted by the smaller works and by large consumers. We have had nothing but satisfaction from their use.

I am intrigued by Birmingham's sensible and evidently reliable method of testing their station meters with rotary meters of substantial capacity and think that the industry generally should derive considerable benefit from the explanations contained in the Paper. When we come to the smaller industrial and domestic meters we have a much more troublesome problem than on our works. If the B.M. meter could be made as a small consumers' meter it might be a success. Presumably the makers have often given consideration to this matter.

While closely associated with the manufacture and repair of consumers' meters, I have never been satisfied with these. There is room for much improvement, particularly in the slot mechanism. It is a fact that both the United States and Germany adopted the slot meter and then set about abandoning these after a lengthy trial. In this connexion I should like to draw attention to the excellent and lengthy critical Paper presented to the Manchester Association in October, 1946, on the faults of the consumers' meter by H. Johnston, Deputy Gas Engineer and Manager of the Bradford Gas Department. In this case, however, it was the valves and not the slot mechanism with which he was dealing.

I am particularly intrigued to learn what the always progressive Birmingham Gas Department have done to cut out the slot mechanism and shall not be satisfied until I have studied this thoroughly. This we hope may be the solution of the trouble many of us have with slot mechanisms.

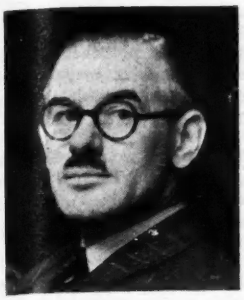
The Authors will reply in writing.

Attendance Records

A schedule of attendances compiled by Dr. W. T. K. Braunholtz shows that a total of 1,225 people attended the Institution meeting. The most largely attended function of the week was the reception and dance, at which there were 1,224 persons present. The other attendances were: President's luncheon, 159; ladies' visit to the Lickey Hills, 149; Saltley Works and Nechells Central Laboratory, 214; Windsor Street Works and Lord Street Depot, 189; Radiation, Ltd., 252; ladies' visit to Kenilworth and Leamington Spa, 122; Austin Motor Co., Ltd., Longbridge Works, 252; General Electric Company, Witton Works, 108; Dunlop Rubber Co., Ltd., Fort Dunlop, 150; Repertory Theatre, Birmingham, 289; theatre dinner, Birmingham, 232; visit to Shakespeare Country: Warwick Castle, 235; lunch at Stratford-on-Avon, 257; theatre dinner and performance of "Romeo and Juliet" at Memorial Theatre, 245.

Golf Results

The Society of British Gas Industries Golfing Circle meeting in conjunction with the Institution meeting was held at Moor Hall Golf Club, Sutton Coldfield, of which the President, Mr. G. C. Pearson is a member, and was attended by 35 members of the Institution and S.B.G.I. The Coronation Plate, for which only members of the Institution are eligible, was won by D. W. Scott after a tie with T. C. Battersby, the result being arrived at on the score for the last seven holes. The Thornton Victory Cup, with which went the Captain's Prize presented by W. H. G. Roach, also resulted in a tie and was won on the result of the last seven holes by C. E. Byrt. In the afternoon a Foursomes against Bogey competition was played for prizes presented by C. R. Averill, a member of the S.B.G.I. Golfing Circle, and was won by J. Hunter Rioch and C. A. Macleod. Only 14 holes were available for play, hence the results came out on the last seven holes. The trophies were presented at the Reception and Dance by Mrs. Pearson, wife of the President.



Education, Recruitment, and Training of Gas Engineers*

By Prof. STACEY G. WARD, Ph.D., M.Sc., D.I.C., A.R.C.S., Assoc.Inst.Gas E.
Department of Chemical Engineering, University of Birmingham

This Paper refers particularly to those who enter the Industry with a University degree. It is upon University graduates that the Industry must in future depend for its leaders and for manning the higher technical posts; the days are passing when articled pupilage on leaving school can be regarded as a most desirable method of entering the technical side of the Industry, and premium pupilage should be obsolete by now.

These remarks are not intended to detract in any way from the technical excellence and skill in management displayed by many gas engineers who have entered the Industry straight from school, as premium pupils, or as assistants in the laboratory or on the plant. It is largely because of the foresight, hard work, grit and determination of such men that the Industry has achieved high efficiency and has assumed the important part which it plays to-day in the domestic and industrial life and economy of Britain: probably, most of them would have welcomed a University approach to the subject had the opportunity or the facilities been as readily available as they are to-day to those who have the ability and the will to learn and to work and to benefit from a University education.

Function of Education

The term "education" is frequently misunderstood. So often is the process of cramming, of inflation with knowledge for subsequent deflation at examinations, mistaken for education. For example, there is at least one school in this country which trains selected pupils to pass University scholarship examinations; these pupils spend an unduly large proportion of their time preparing model answers to questions. They frequently obtain exceptionally high marks in their scholarship examinations, but they are not being properly educated, and their early promise is often not borne out at the University.

Education is a process of development of character and mental powers; it should not be a process of pouring in of facts. Neither should it be vocational at school nor at the University. Few boys at school know exactly what they want to do in life, which career eventually to take up; although at, say, the school certificate or matriculation stage most boys know whether they wish to go on to the science side with a view to a career in science or in engineering. Those with the ability and opportunity to do so stay at school for a further two or three years, spending a large proportion of their time on scientific subjects. Specialization at this stage should, however, be restricted, and in addition to mathematics, physics and chemistry, the curriculum should include English, a foreign language, history, and other liberal subjects.

At the higher school certificate stage those boys who intend to go to the University usually know whether they wish to take pure science (*i.e.*, chemistry or physics, or mathematics), or applied science (*i.e.*, some branch of engineering). Those electing to read civil, mechanical or electrical engineering follow undergraduate courses in the subject, but a boy who wishes to make a career in a branch of chemical engineering has two avenues of approach open to him: either he may take an undergraduate course in chemical engineering, or he may take a first degree in chemistry followed by a post-graduate course in chemical engineering. It is only comparatively recently that degree courses in chemical engineering as such have been available at Universities in Britain, although courses based largely on chemical engineering have been available in some Universities for some time. An example is the degree course in gas engineering at the University of Leeds; other examples are degree courses in coal utilization and in oil engineering and refining (both now superseded by an honours degree course in chemical engineering) at the University of Birmingham.

The University education of an engineer is a means of providing a knowledge of the sciences and fundamental principles upon which the subject, whether civil, mechanical, electrical or chemical engineering, is based, and of so training the mind that the student in due course is able to apply to practical problems the fundamental knowledge he has acquired. This calls for close co-operation between the University and the industry concerned; for while the responsibility for fundamental education rests primarily with the University, only industry can provide opportunities for the practical training so essential. At certain Universities, students of chemical engineering are required, as part of their University course, to obtain practical experience by working, during the summer vacations, at approved works. Many firms, including certain gas undertakings, already provide facilities for such training, and it is hoped that others, including other gas undertakings, will introduce similar organized facilities, and thus help to ensure that graduates in chemical engineering will have some idea of works practice and will have a sense of industrial proportion only to be acquired by practical experience. This experience supplements, during vacations, the laboratory course of the University, which are designed to-day to illustrate the theoretical work dealt with in lectures, to train students in scientific methods of observation, measurement and analysis of results, and to develop the power to draw and present conclusions in a logical manner.

In the course at Birmingham the practical chemical engineering work is extended to include a period of a week or a fortnight each year at a suitable works where, under the direction of a member of the University staff students carry out a full test on a suitable portion of the plant so as to investigate, for example, the efficiency of a still, or a benzole scrubber, or a boiler or any piece of plant illustrating either one or more of the unit processes involved in chemical engineering, or practical problems in heat transfer, fluid flow, &c., where the basic principles covered at the University can be applied.

A University education in chemical engineering has the advantage that the laboratories are used for research as well as for teaching, so that the student works in an atmosphere of scientific inquiry. The research section of a University chemical engineering department is at least as important as the teaching section; they are, in fact, complementary, for without research teaching lacks vitality and inspiration.

Research in chemical engineering at a University is carried out by teams which may include not only chemical engineers, but also pure chemists and pure physicists who, as part of their research training, also follow courses in chemical engineering. The scope of the research is wide. At Birmingham, for example, subjects of research now being carried out include combustion of fuels, properties of suspensions, laws of motion of solids in fluids, constitution and chemistry of coal, constitution of tar, heat transfer, azeotropic distillation and synthesis of hydrocarbons, while subjects to be introduced when staff is available include adsoprtion, carbonization of coal, and work on refractories. Such research is of particular value to the Industry, not only because it is a means of increasing fundamental knowledge, but also because it is a training ground for graduates who will become specially suited to investigate problems in the Industry.

Recruitment and Training

Training of a graduate who enters the Gas Industry is the responsibility of the Industry. So often this training is quite haphazard and the man fresh from the University is left to acquire knowledge of the Industry as best he can. This training should be carefully organized and directed so that the trainee follows a predetermined course in which he is not only learning but is also carrying out useful work. In parallel with training at the works the trainee should attend courses in gas engineering at a technical college to broaden his knowledge of the specialized application of his basic engineering subject (civil, mechanical or chemical) to the subject of gas engineering so that, in time, he will qualify for Associate Membership, and

* Communication No. 317 of the Institution of Gas Engineers.

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later full Membership, of the Institution. In many cases it may be possible for the trainee to be given half a day or even a whole day off each week for attendance at technical college classes. Correspondence courses provide an alternative, but much less desirable, method.

Courses in gas engineering at technical colleges are arranged primarily for those who enter the Industry direct from school. They are arranged so that the students, according to standard, may prepare for the Ordinary or Higher Grade Examinations, or for the Diploma, in Gas Engineering. Unfortunately, these are the only courses which graduates in engineering can attend, for specialized classes in gas engineering, and even the senior classes, contain much material which will have been included in the University courses taken by mechanical and especially chemical engineers. Sitting through courses of this nature has an adverse effect on the young graduate and indirectly influences recruitment. Two students likely to graduate shortly in chemical engineering had considered the possibility of entering the Gas Industry, but they have decided not to do so because a friend who entered the Industry, and who, incidentally, is working under good conditions and is happy and even enthusiastic about his work, felt so irked by the inadequacy of the courses at the local technical college (*i.e.*, for graduates) that he gave up attendance and attempted a correspondence course with which he soon became disappointed because of the ancient text-books recommended. A young graduate of the right calibre for the Gas Industry is keen, on entering the Industry, to widen his knowledge of the subject; however considerate and helpful his particular undertaking and his superiors may be, he becomes disappointed if his appetite for gaining knowledge is not satisfied. Allowing for the impatience of youth, there is no doubt that recruitment at University level will be well below the requirements of the Industry if suitable arrangements are not made to cater for the attempts of such men to widen their horizons of general knowledge of gas engineering.

The Human Side

Recruitment from the Universities of mechanical and chemical engineers for the Gas Industry will become increasingly difficult if the Industry fails to realize and to make allowances for the human side of gas engineering. To-day there are less than 200* students taking courses in chemical engineering at British Universities; possibly about 40 will graduate this year, about 60 next year and about 90 in two years' time. Of those graduating this year eight or 10 will go as chemical engineers to oil companies abroad; each of the remainder will be in the position of having a choice of several different posts.

With competition so great, it may be useful to analyze why one particular industry or post is selected in preference to another. In some cases the graduate for purely personal reasons may have decided on a particular industry or a particular locality, but as far as chemical engineers are concerned it is a matter of weighing up the advantages and disadvantages of available posts. The experience of friends in industry is sought; the professor is consulted, amenity is considered; prospects are discussed; personalities of executives or departmental managers, and so forth, are taken into account. The student leans towards those posts where facilities for learning the job are freely provided, where possible prospects are known; where a sympathetic management takes an interest in the progress of younger members of the organization. The young graduate in chemical engineering to-day has not been spoon fed at the University, and certainly must not be spoon fed in industry; he does not jib at hard work nor at dirty work; but he does jib at not having enough to do, at lack of facilities for extending his knowledge, and at apparent lack of interest of superiors.

Conclusions

It is submitted that recruitment by the Gas Industry of chemical engineers from the Universities will be made easier if attention be paid to the following points:

1. Encouraging students to visit gas-works and, on such visits, providing guides who can answer not only questions concerning plant and process but also questions concerning the exact nature of the work of different employees, especially of graduates, from the youngest on the works to executives.
2. Giving full information of prospects, when interviewing candidates. The usual "prospects, of course, depend entirely upon the way you work" is not a satisfactory reply to a potential recruit. He wants to know the chances of promotion if he works well, what the various posts in the organization for which he may eventually be available are, and an approximate idea of the salary ranges.
3. Introduction of an organized and well directed course of training for the newcomer.
4. Introduction of courses at selected technical colleges (or at larger works) for graduates in chemical engineering who wish to extend their knowledge of the principles of gas engineering.
5. Access to the works library, and opportunity to read text-books and current technical journals.
6. Ensuring that there is a sympathetic human attitude, which can be achieved without coddling, to works life, including
   (*a*) real interest in immediate superiors and departmental managers in the young graduate's progress and work generally, coupled with constructive criticism, as occasion suggests;
   (*b*) dissemination of information concerning plant alterations and extensions, technical policy, so that younger members of the staff feel that they are really part of the organization;
   (*c*) recognition of professional values by granting time off occasionally to attend meetings of technical institutions when suitable papers are to be discussed;
   (*d*) occasional visits to other works, especially to inspect new plant or new processes;
   (*e*) maintenance of discipline coupled with freedom from petty restrictions and annoyances. No member of staff is so critical of lax discipline or of unnecessary impositions as a graduate fresh from the University.
7. Payment of adequate remuneration which should not be less than that applying in parallel cases in other industries not only in the initial stages but also and particularly in the intermediate stages, before reaching executive status; this is important if the Industry is to secure and retain the services of the best of the students graduating in chemical engineering.
8. Revision of certain regulations concerning admission to Corporate Membership of the Institution, so that graduates in chemical engineering of approved Universities may be allowed concessions similar to those granted to graduates in gas engineering of British Universities.

It is hoped that this short Paper will promote a useful discussion of the questions of education, recruitment, and training of the gas engineer. The thesis held is that education comes first and should be on broad lines and non-vocational; recruitment of those who have a suitable educational background for the Industry depends upon legitimate inducement which the Industry can offer from the point of view of remuneration, of considerate treatment on the human side, of organized initial training and reasonable prospects of advancement; training depends primarily upon the Industry itself, and should be properly organized and directed so that adequate experience of each section of the work is covered.

The Institution's booklet, "Careers in the Gas Industry," is directed to all possible entrants to the Industry. It is submitted that a similar booklet, discussing careers in the Gas Industry open to graduates, would be a useful influence in recruitment especially if the following statement occurring in Col. C. M. Croft's admirable Foreword to the booklet be amplified and illustrated:—

"Those making up their mind to start a career in the Gas Industry and availing themselves of the opportunities thus opened up, are offered great possibilities of success and a secure future in whatever branch of the Industry they select."

* The corresponding figure for American Universities is about 3,000.

Functional Cost Accounting

A very well presented book, written by a specialist in the subject who has applied practical tests over a number of years to his theories, has been published by J. E. Powers, F.C.W.A., under the title of *Functional Cost Accounting in the Liverpool Gas Company*. The Author has proved by experience that his system has justified its introduction, stressing however the vital point that "it has proved a success *because it has been used by the management*." Managements in the Gas Industry generally speaking have hedged at the expense incurred in setting up a Costing Department, half hearted attempts only being made in this direction. There is, however, to-day a keen desire to analyze and interpret expenditure and receipts to their fullest extent and Mr. Powers' book would be of considerable assistance to compare existing or help in establishing new costing systems.

I like very much his method of dealing with the costing of "Running Supplies for and Fixing Meters and Appliances" in Chapter IX. This not only ensures that each job bears its appropriate share of overhead expenses but also deals fairly as between one consumer and another, by relating the expenses to the value of only the work in the house. How thoroughly he has done this is demonstrated by the separate costing of such items as Phoning Time.

Other Departmental costing methods are as fully described an well illustrated. The book is a very welcome addition to the all too few publications dealing with this side of the Gas Industry.—J.D.T.

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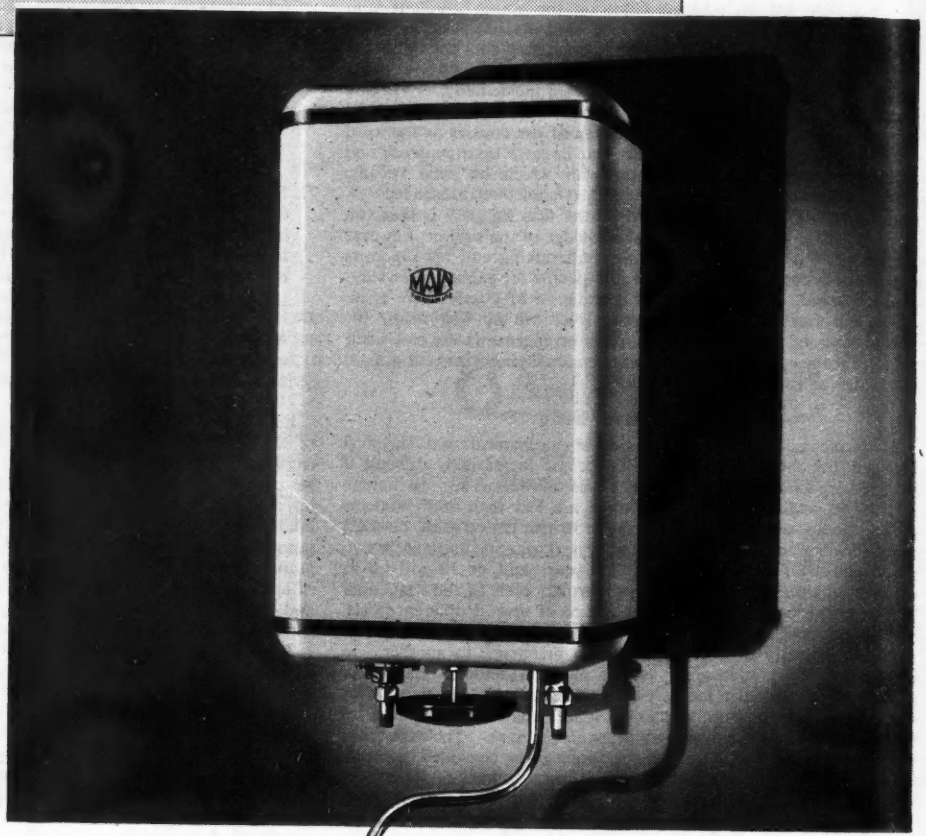

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Personal

Manchester City Council has appointed Mr. J. W. WEATHERHEAD to the position of Assistant Commercial Manager and Secretary of the Gas Department. Mr. Weatherhead is at present Commercial Manager of the Salford Gas Department.

* * *

In accordance with their policy of associating experienced members of the staff with the management of the Company, the Visco Engineering Co., Ltd., Croydon, have elected Mr. FRED C. SMITH (Works Manager), Mr. L. C. ELLIS (Chief Engineer), and Mr. E. H. HILTON (Secretary) to the Board of Directors. Each of the new Directors has had nearly 20 years' service with the Company.

* * *

Lord SIMON OF WYTHENSHAWE, Governing Director of the Simon Engineering Group, which includes Henry Simon, Ltd., Simon-Carves, Ltd., and Turbine Gears, Ltd., has been appointed Chairman of the B.B.C. He was lately nominated as a member of the Royal Commission to enquire into the freedom of the Press, but it is understood that he is offering his resignation in view of his new appointment.

* * *

Mr. F. T. RENNISON is retiring at the end of June from his position as Industrial Gas Superintendent to the Sheffield and District Gas Company after over 36 years' service. At a social function held on June 12, at which Mr. Ralph Halkett, General Manager, presided, Mr. Ralph Halkett, Senior, a Director of the Company, made a presentation to Mr. Rennison on behalf of the officials. Mr. Rennison has also been the recipient of gifts from members of the staff and workmen of other departments. Joining the staff in 1910 as Gas Engine Inspector, having previously been with Messrs. George Bray, of Leeds, he was appointed to the position of Fittings Superintendent in 1918, and was responsible for the development of the Furnace Section of the Fittings Department. On the formation of a separate Industrial Department in 1920 Mr. Rennison was appointed Industrial Superintendent.

* * *

The Birthday Honours List issued on June 12 announced the bestowal of C.B.E. on Lieut.-Colonel SHOLTO S. OGILVIE, D.S.O., who retired from the Joint Managership of the National Gas Council last year after having filled that office since 1918. In addition to his work for the National Gas Council, Colonel Ogilvie was for 23 years Joint Hon. Secretary of the Conioint Conference of Public Utility Associations, and on his retirement from that office early this year he was presented with a portrait of himself by Frank Salisbury, the famous painter. The C.B.E. was also awarded to Mr. W. NEWTON BOOTH, Chief Mechanical Engineer and Superintendent of Building Works at Woolwich, formerly Assistant Engineer at Halifax and Huddersfield Gas Departments, who gave one of the William Young Memorial Lectures to the North British Association of Gas Managers, and was at one time President of the London and Southern District Junior Gas Association. Mr. BERNARD F. BROWNE, Regional Gas Officer for the North East Region, received the O.B.E., and Mr. M. W. BURT, Manager and Secretary of the Society of British Gas Industries, received the M.B.E. Another recipient of the M.B.E. was Mr. E. H. T. HOBLYN, Secretary of the British Chemical Plant Manufacturers' Association.

Obituary

The death occurred at Lugano, Switzerland, on June 16, after a long illness, of Major JULIAN DAY, Chairman of Gas Consolidation, Ltd., and the Severn Valley Gas Corporation, Ltd. He was a Director of 52 companies and Chairman of 22.

Diary

June 19.—Industrial Gas Development Committee, Gas Industry House, 2.30 p.m.

June 20.—Manchester District Association of Gas Engineers: President's Day; Visit to Blackpool.

June 23.—London and Counties Coke Association: Finance Committee, 11 a.m.; Executive Committee, 11.30 a.m.; Central Committee, 1.30 p.m.; Gas Industry House.

June 25.—B.G.C. Domestic Development Committee, 10.30 a.m. Gas Industry House.

June 26.—Southern Association of Gas Engineers and Managers: Summer Meeting, Finchley.

June 27.—Waverley Association of Gas Managers: Annual Meeting, Y.M.C.A. Hall, South St. Andrew Street, Edinburgh, 10.30 a.m.

June 30.—Annual Meetings of British Commercial Gas Association, 2.30 p.m.; National Gas Council, 2.45 p.m.; British Gas Council (Incorporated), 3 p.m.: Federation of Gas Employers, 4 p.m. Gas Industry House.

Eastern Junior Gas Association

The first Annual General Meeting of the newly-formed Eastern Junior Gas Association was held in the Demonstration Room of the Peterborough Gas Showrooms on June 11, by invitation of the Peterborough Gas Company. It was originally planned that Mr. F. N. Howes, President of the Eastern Association of Gas Engineers and Managers, should take the Chair, but in his absence Mr. F. A. Rhead, Engineer, Manager, and Secretary of the Peterborough Gas Company, fulfilled that duty.

Opening the meeting, Mr. Rhead explained that Mr. Howes had been taken ill, but conveyed to the gathering his good wishes. It was also unfortunate that Mr. J. Hunter Rioch, Managing Director, Engineer and Secretary of the Cambridge University and Town Gas Light Company, had an important engagement outside Cambridge and was thus unable to be present. It was hardly necessary to say that Mr. Hunter Rioch was the prime mover in starting the Association. He (Mr. Rhead), on behalf of the Eastern Association, was glad to take the opportunity of wishing this new venture every success.

The results of the ballot for the Officers of the Association was announced by Mr. **R. W. Hilham** (Colchester), himself elected Hon. Secretary and Treasurer. Mr. J. S. Marshall (Lincoln) was elected President, Mr. H. J. Patching (Peterborough) and Mr. J. T. Brookes (Norwich), Vice Presidents. A postal ballot last March had determined the Ordinary Members of Council, namely, Messrs. J. Anderton (Great Yarmouth), G. Davies (Great Grimsby), S. G. J. Horrod (Watford and St. Albans), and R. E. Parsons (Bedford).

The **President** then took the Chair and warmly thanked Mr. Rhead for stepping into the breach in the absence of Mr. Howes. He was convinced that the new Association filled a long-felt want in the Eastern area and he was equally confident that most companies and corporations would allow Juniors to attend. At first they must tread carefully, but once established, he believed their success was assured.

The Secretary reported that apologies for absence had been received from Mr. F. N. Howes, Mr. J. Hunter Rioch, Mr. R. A. Weston (Norwich), Mr. F. Allen (Clacton), Mr. H. H. Redwood (Newmarket), and other members of the Eastern Association. He then read the Minutes of the last meeting. The four representatives nominated and elected to serve on the Eastern Association of Gas Engineers and Managers, District Education Committee, were Messrs. D. H. Winch (Cambridge), H. F. S. Birks (Spalding), E. S. Dennis (Colchester), and S. C. Porter (Ipswich). The Council had appointed Mr. J. S. Marshall, Mr. H. J. Patching, and Mr. R. W. Hilham as delegates to serve on the British Junior Gas Association Joint Council. There followed the nomination of Auditors and by popular consent Mr. T. W. Benstead (Clacton) and Mr. A. F. Dann (Maldon) were elected to that post.

Mr. **H. J. Patching** then rose to propose "that Mr. J. Hunter Rioch be asked to accept the first Honorary Membership of the Association for services so ably rendered in connexion with its formation." The idea of forming a Junior Association had been sponsored by the Education Committee of the Senior Association, but all the work had been done under the Chairmanship of Mr. Hunter Rioch. He had been one of six on the Ad Hoc Committee, but in his own mind and, he felt sure, in those of the other Committee members, there was no doubt that the Committee *was* Mr. Hunter Rioch. He had foreseen all the snags and placed all his energy and ability at their disposal. His part had been not one of a dictator but an adviser, and upon his advice they had formed a fine set of rules which could, of course, be amended from time to time.

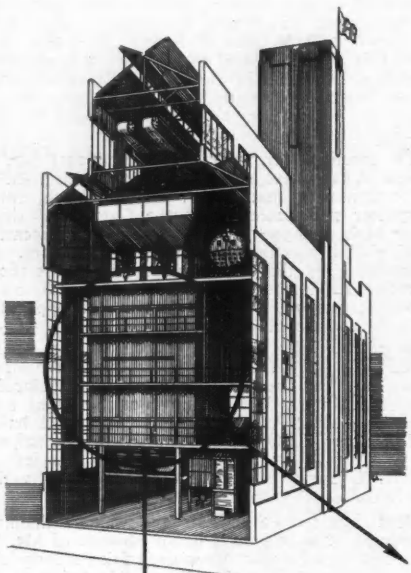
The proposition was seconded by the **Secretary** who, remarking that he also had been a member of the Ad Hoc Committee, wished to add nothing to what Mr. Patching had said; he had given a complete resumé of Mr. Hunter Rioch's work and he could think of no better guide for those early days. He would now be able to see his baby grow from strength to strength.

The proposition was carried unanimously.

Continuing, the **Secretary** announced forthcoming activities of the Association, which included the Presidential Address at Lincoln, on Sept. 24, a visit to Watford some time in November and to Norwich on March 17. They were also to receive a Paper on main-laying.

The **President** then proposed a vote of thanks to the Peterborough Gas Company for the use of the excellent room and facilities; to members of the Ad Hoc Committee, including Messrs. L. C. Coleman (Bury St. Edmunds), J. Halls (Cambridge), and E. S. Dennis (Colchester); and to the Dean of Peterborough for permission to have a photograph taken before the Cathedral—a favour only granted in particular cases.

The meeting concluded with a show of new British Gas Council films, using the new and most efficient projection and sound equipment recently acquired by the Peterborough Gas Company, after which a group photograph was taken and the members were entertained to tea.



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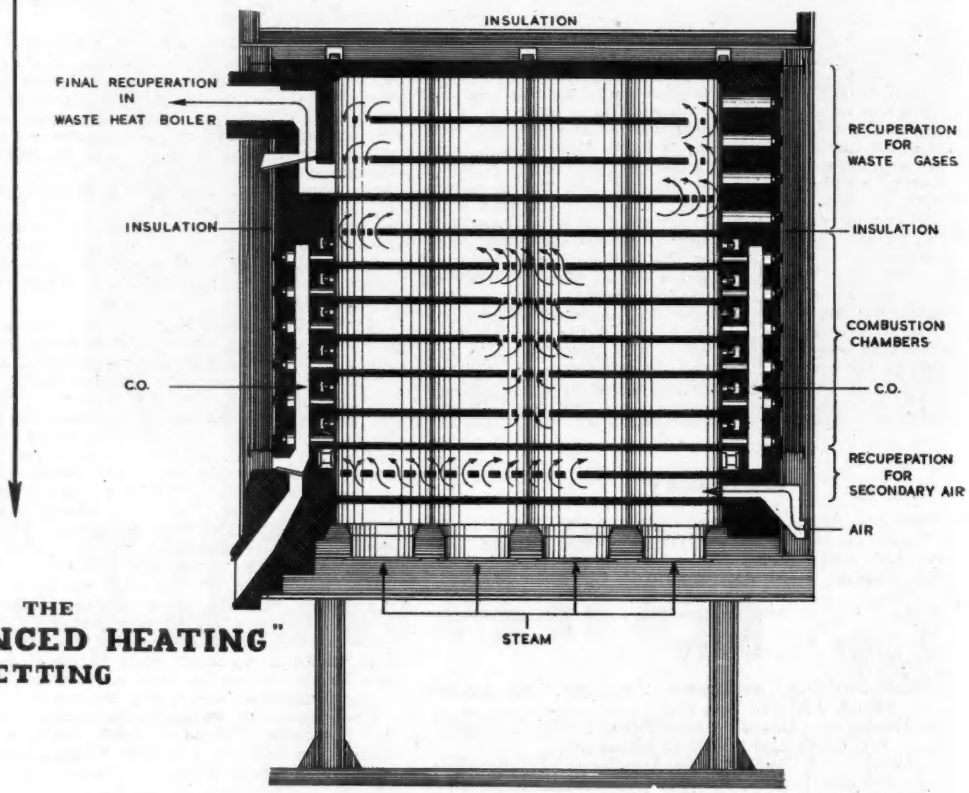

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Women's Gas Council Annual General Meeting

At the Annual General Meeting of the Women's Gas Council, leading representatives of the Gas Industry praised the work of the Council and expressed appreciation of the excellent work of Mrs. G. Abbott, as Organizing Secretary, to whom on the occasion of her retirement a presentation was made. Mrs. Abbott has now been succeeded by Mrs. W. M. Buchanan.

The meeting, held at Gas Industry House, was presided over by the Dowager Lady Nunburnholme, who accepted re-election for another term of office as President in view of the loss that the Council was sustaining in Mrs. Abbott's retirement.

A tribute to the work of the W.G.C. was paid by Mr. Michael Milne-Watson, Governor of the Gas Light and Coke Company, who recalled the founding of the Council in 1935 by his father, the late Sir David Milne-Watson, and said that the meeting was proof of the wisdom of the idea that there should be more than one link between the Industry and the consumer.

Women's Organizations Important

"The most important consumer of gas," said Mr. Milne-Watson, "is the woman in the home, and also, quite rightly, the most critical. Make your voices heard; we need the advice that you can give us. Don't be put off by recent remarks of the Minister of Fuel and Power on women's organizations!"

Mr. Milne-Watson said that although the war had caused a slight setback to the W.G.C., which developed very rapidly after its formation, the organization was now in process of rejuvenation and was going from strength to strength. The Government called in the W.G.C. when fuel rationing was under discussion, but it was another story whether their advice had been followed. There were now more branches than at any time, but the Council should not be content until this number was doubled, as they were doing most useful and interesting work.

Although kitchen equipment had improved enormously during the past few years and would continue to improve, on account of the present economic position women would have to exercise patience if they could not get the equipment they longed for at once. During the next few years, when there would be big developments in kitchen planning, the women should continue to make their voices heard about their exact requirements.

Colonel H. C. Smith, Chairman of the British Gas Council, said that the Industry had always prided itself on having available all the gas that the consumer could need. The slogan "The consumer must never be let down" went right through the Gas Industry from manager to stoker. Recent pressure reductions since the war, on the instructions of the Minister of Fuel and Power, had been painful to the Industry, which unfortunately had no control over the type of coal available or the materials for plant repair, and the fact that although they knew a cold spell was likely last winter they were unable to plan to meet this as they would have done without war-time restrictions and existing controls.

Mr. J. R. W. Alexander, General Manager of the British Gas Council, said that the most important development of the work of the Women's Gas Council was the recently organized Homecraft Courses, which would make the greatest possible contribution to the prosperity of the country in ensuring happy homes.

Annual Report

The Twelfth Annual Report of the Women's Gas Council was read by Mrs. Abbott giving a picture of the wide activities of the Council during the past year. Of special import were the Homecraft Courses organized on the lines of the Government Circular 117, "Further Education Homecraft," issued by the Ministry of Education. In several cases Branches have been formed as a result of these Courses and others will soon follow, so that it is obvious that the experiment has been a success and justifies the belief of the Executive Committee that work in this and similar directions should be developed.

Mrs. Abbott also referred to the editing of the magazine *Fanfare*, and asked to be allowed a personal note of thanks to all who had helped and advised her in this work and that of the monthly leaflets, which she greatly regretted relinquishing. The circulation of these leaflets, said Mrs. Abbott, extended to Italy, Australia, and the U.S.A.

Among the other activities of the W.G.C. mentioned in the Report were the formation of thirteen new branches, a planned kitchen and gas installation in a convertible house designed by Mr. Clive Pascall, A.R.I.B.A., display and exhibition material, lectures, and the formation of the new Design Advisory Panel, also co-operation with the National Institute of Houseworkers, the British Management Council, the National Council of Women, the Housing Centre, and participation in the Ministry of Fuel Conference.

Changes and additions in staff mentioned by Mrs. Abbott included the appointments of Miss Isabel Grant and Mrs. Ferrow and the resignation of Mrs. Malet, who was thanked for the able carrying of responsibility during her six years as office secretary.

Mrs. Abbott (left) introduces Mrs. W. M. Buchanan, her successor, to Lady Nunburnholme (right).

Mrs. Abbott said: "It is with sincere regret that I am resigning from the post of Organizing Secretary which I took over at the request of the Executive Committee in November, 1941. I have been keenly interested in the development of the Women's Gas Council and believe that the future holds immense possibilities for extending its work, and that valuable help can be given to housewives in the planning, equipping, and running of their houses, which cannot fail to contribute to raising the standard of the home life of the nation."

Presentation to Mrs. Abbott

Miss K. M. Halpin, O.B.E., Chairman, paid a tribute to Mrs. Abbott's "forward vision" and said that she had succeeded in building up the Council so that it could go on from strength to strength. After introducing Mrs. W. M. Buchanan, Mrs. Abbott's successor, Miss Halpin presented Mrs. Abbott with a cheque as a token of the members' appreciation and regard. In returning thanks, Mrs. Abbott said that she was deeply touched, as what she had done had been a labour of love. Now she would be able to devote more time to her seven grandchildren, who really believed that she had been spending her time collecting pennies and shillings from the meters!

In addition to the re-election of the President, the Vice-Presidents were re-elected with the exception of Miss Adler, who did not desire this. Mrs. Abbott, Miss Dodd, and Miss Wilde were elected to fill vacancies on the Executive Committee.

Good wishes are extended to Mrs. Buchanan for success in her new responsibilities.

The Telephone Number of the Building Centre (all sections) has been changed to Mayfair 8641-8646.

To Mark the Centenary of the Company, John E. Williams & Co., Ltd., Victoria Paint Works, Partington, Manchester, are granting all employees a full day holiday on June 25 and taking them to Blackpool.

The Institution of Heating and Ventilating Engineers will hold its summer meeting at Eastbourne on June 23-25, under the Presidency of Mr. E. A. Couzens. The business meeting will be held at the Grand Hotel on June 24 at 10.15 a.m., when Mr. A. F. Dufton will present a Paper on "More Warmth with Less Fuel."

The Waverley Association of Gas Managers will hold its annual meeting at the Y.M.C.A. Hall, South St. Andrew Street, Edinburgh, on June 27, at 10.30 a.m., when Mr. James Dickson, Dundee, will deliver his Presidential Address. The meeting will be followed by a luncheon at the North British Station Hotel. Golf competitions will be held over the Baberton Golf Course on June 26 at 10 a.m. and 2 p.m.